...ARY

VOLUME XXVIII

DEC. 24 193

JOURNAL
OF THE
AMERICAN STATISTICAL ASSOCIATION

DECEMBER, 1933

CONTENTS

A SOCIAL-ECONOMIC GROUPING OF THE GAINFUL WORKERS OF THE UNITED STATES. By Alba M. Edwards 377

A STATISTICAL METHOD FOR ESTIMATING THE DISTRIBUTION OF SIZES OF COMPLETED FRATERNITIES IN A POPULATION REPRESENTED BY A RANDOM SAMPLING OF INDIVIDUALS. By Barbara S. Burks 385

KARL PEARSON AND MATHEMATICAL STATISTICS. By Burton H. Camp 395

CRITERIA OF DIFFERENTIAL MORTALITY. By Harold F. Dorn and Samuel A. Stouffer 402

PREDICTING RELIEF CASE LOADS FOR MINNEAPOLIS BY EMPIRICAL PROCEDURES, 1932-1933. By F. Stuart Chapin, Ernst Jacobson and Sarah Stone 414

MEASURES OF THE INEQUALITY IN THE PERSONAL DISTRIBUTION OF WEALTH OR INCOME. By Dwight B. Yntema 423

NOTES:

A Test for Significance in a Unique Sample. By A. E. Brandt 434

The Central Statistical Board (438); Committee on Government Statistics (439); The National Recovery Act and Retail Prices (440); Progress of the Census (444); Miscellaneous Notes (448); Members Added (457).

REVIEWS 459

PUBLISHED QUARTERLY BY THE
AMERICAN STATISTICAL ASSOCIATION
PUBLICATION OFFICE: Rumford Press, Concord, N. H.
EDITORIAL OFFICE: Columbia University, New York City

Price $1.50 per copy $6.00 per annum

2

NO. 184 (VOL. XXVIII) DECEMBER, 1933

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

Formerly the Quarterly Publication of the American Statistical Association

CONTENTS

A SOCIAL-ECONOMIC GROUPING OF THE GAINFUL WORKERS OF THE UNITED STATES. By ALBA M. EDWARDS 377

A STATISTICAL METHOD FOR ESTIMATING THE DISTRIBUTION OF SIZES OF COMPLETED FRATERNITIES IN A POPULATION REPRESENTED BY A RANDOM SAMPLING OF INDIVIDUALS. By BARBARA S. BURKS 388

KARL PEARSON AND MATHEMATICAL STATISTICS. By BURTON H. CAMP 395

CRITERIA OF DIFFERENTIAL MORTALITY. By HAROLD F. DORN and SAMUEL A. STOUFFER 402

PREDICTING RELIEF CASE LOADS FOR MINNEAPOLIS BY EMPIRICAL PROCEDURES, 1932-1933. By F. STUART CHAPIN, ERNST JACOBSON and SARAH STONE 414

MEASURES OF THE INEQUALITY IN THE PERSONAL DISTRIBUTION OF WEALTH OR INCOME. By DWIGHT B. YNTEMA 423

NOTES:

A TEST FOR SIGNIFICANCE IN A UNIQUE SAMPLE. By A. E. BRANDT 434

THE CENTRAL STATISTICAL BOARD (438); COMMITTEE ON GOVERNMENT STATISTICS (439); THE NATIONAL RECOVERY ACT AND RETAIL PRICES (440); PROGRESS OF THE CENSUS (444); MISCELLANEOUS NOTES (448); MEMBERS ADDED (457).

REVIEWS: Frisch: *Pitfalls in the Statistical Construction of Demand and Supply Curves*, by E. W. Gilboy (459); Mosher and Crawford: *Public Utility Regulation*, by E. S. Mason (462); Secrist: *The Triumph of Mediocrity in Business*, by H. Hotelling (463); Ricardo: *Minor Papers on the Currency Question, 1809–1823*, by H. P. Willis (465); Van Sickle: *Direct Taxation in Austria*, by R. M. Haig (467); Morgan (Ed.): *Agricultural Systems of Middle Europe*, by J. E. Boyle (470); Robinson: *Straw Votes*, by R. O. Lang (472); National Industrial Conference Board: *Taxation of Motor Vehicle Transportation*, by C. Shoup (474); Wiggs: *Unemployment in Germany Since the War*, by W. T. Ham (475); Berle and Means: *The Modern Corporation and Private Property*, by S. Peterson (477); Power and Postan (Eds.): *Studies in English Trade in the Fifteenth Century*, by A. P. Usher (480); White: *Social Statistics*, by L. S. Kellogg (481); Westergaard: *Contributions to the History of Statistics*, by W. F. Willcox (483); Remer: *Foreign Investments in China*, by J. E. Orchard (484); Vakil, Bose and Deolalkar: *Growth of Trade and Industry in Modern India*, by J. E. Orchard (486).

Published quarterly by the American Statistical Association

RUMFORD PRESS BUILDING, CONCORD, N. H.

Editorial Office, Columbia University, New York City

Entered at the post-office, Concord, N. H., as second-class mail matter

Acceptance for mailing at the special rate of postage provided for in Section No. 1103, Act of October 3, 1917, authorized April 29, 1922

Officers of the American Statistical Association

ORGANIZED NOVEMBER 27, 1839

PRESIDENT	Stuart A. Rice	
DIRECTORS	Donald R. Belcher	Malcolm C. Rorty
	Robert E. Chaddock	Carl Snyder
	Louis I. Dublin	Edgar Sydenstricker
VICE-PRESIDENTS	Melvin T. Copeland	Arthur H. Richardson
	Frederick C. Mills	George B. Roberts
	Horatio M. Pollock	Henry Schultz
	Lowell J. Reed	William M. Steuart
SECRETARY-TREASURER	Willford I. King	
	Room 530, Commerce Building, New York University	
	236 Wooster Street, New York City	

CHAPTER AND DISTRICT SECRETARY

ALBANY CHAPTER
David M. Schneider, *New York State Department of Social Welfare, Albany, New York*

AUSTIN (TEXAS) CHAPTER
Carroll D. Simmons, *University of Texas, Austin, Texas*

BOSTON CHAPTER
Roswell F. Phelps, *Massachusetts Department of Labor and Industries, Boston, Massachusetts*

CHICAGO CHAPTER
Mrs. Bernice Lamb, *Federal Reserve Bank of Chicago, Chicago, Illinois*

CLEVELAND CHAPTER
Edward A. Stephen, *Bell Telephone Company, Cleveland, Ohio*

COLUMBUS (OHIO) CHAPTER
Howard G. Brunsman, *Bureau of Business Research, Ohio State University, Columbus, Ohio*

CONNECTICUT CHAPTER
Chester H. Whelden, Jr., *Yale University, New Haven, Connecticut*

LOS ANGELES CHAPTER
J. L. Nicely, *Room 400, Union Oil Building, Seventh and Hope Streets, Los Angeles, California*

PHILADELPHIA CHAPTER
Hiram S. Davis, *University of Pennsylvania, Philadelphia, Pennsylvania*

PITTSBURGH CHAPTER
John D. Beatty, *Carnegie Institute of Technology, Pittsburgh, Pennsylvania*

SAN FRANCISCO CHAPTER
Robert W. Bachelor, *Federal Reserve Bank, San Francisco, California*

AREA REPRESENTED AND DISTRICT SECRETARY

DETROIT AND VICINITY
John W. Scoville, *Chrysler Corporation, Detroit, Michigan*

WASHINGTON AND VICINITY
Thomas B. Rhodes, *Federal Reserve Board, Washington, D. C.*

EDITOR	Frank Alexander Ross	
	405 Fayerweather Hall, Columbia University, New York City	
REVIEW EDITOR	Leo Wolman	
	30 Fifth Avenue, New York City	
ASSOCIATE EDITORS	Edmund E. Day	Edgar Sydenstricker
	Wesley C. Mitchell	Walter F. Willcox

NO. 184 (VOL. XXVIII) DECEMBER, 1933

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

A SOCIAL-ECONOMIC GROUPING OF THE GAINFUL WORKERS OF THE UNITED STATES

By Alba M. Edwards, *Bureau of the Census*

In June, 1917, there was presented in this Journal a grouping of the gainful workers of the United States into nine social-economic groups. The real need for such a grouping is shown by the use that has been made of that one. In the present article, this 1917 grouping is revised and 1930 census figures are presented.

As stated in the earlier article, a classification of all occupations according to skill, if it could be made, would be very useful; but a complete classification by skill is impossible, since many occupations do not lend themselves to such a classification. Indeed, none of the professional, proprietary, official, managerial, or clerical pursuits lends itself readily to a classification by skill; and it is doubtful whether any of them may be properly so classified, since in none of them is skill or manual dexterity the chief characteristic. In fact, only those occupations in which the expenditure of muscular force is an important characteristic can be properly classified by skill. While it is plainly impossible to draw a hard and fast line between those occupations characterized principally by the exercise of muscular force or manual dexterity, and those characterized chiefly by the exercise of mental force or ingenuity—or between hand workers and head workers—such a line of demarcation may be made sufficiently exact for our purpose.

The grouping of the gainful workers here presented is not based on skill, except in the case of Groups 4, 5, and 6, most of the occupations in which may be more or less readily classified by skill.

In the construction of these three groups those occupations are considered skilled for the pursuance of which a long period of training or an apprenticeship is usually necessary, and which in their pursuance call for a degree of judgment and of manual dexterity, one or both, above that required in semiskilled occupations. Those occupations are considered semiskilled for the pursuance of which only a short

period or no period of preliminary training is necessary, and which in their pursuance call for only a moderate degree of judgment or of manual dexterity. Unskilled occupations are considered to include those the workers in which require no special training, judgment, or manual dexterity, but supply mainly muscular strength for the performance of coarse, heavy work.

Unfortunately, it has not been possible to classify all manual workers as skilled, semiskilled, or unskilled strictly according to the above concepts. In each group of manual workers, certain of the occupations include some workers who would be better classified by skill in one of the other groups. In fact, each of the groups here presented doubtless contains some workers who do not actually belong there—and some workers who have been included principally for want of a more appropriate place for them. In no group, however, are such workers numerous enough to affect the group total materially.

The occupations of the gainful workers of the United States have been arranged in the following groups:

1. Professional persons
2. Proprietors, managers, and officials
   - 2-a. Farmers (owners and tenants)
   - 2-b. Wholesale and retail dealers
   - 2-c. Other proprietors, managers, and officials
3. Clerks and kindred workers
4. Skilled workers and foremen
5. Semiskilled workers
   - 5-a. Semiskilled workers in manufacturing
   - 5-b. Other semiskilled workers
6. Unskilled workers
   - 6-a. Farm laborers
   - 6-b. Factory and building construction laborers
   - 6-c. Other laborers
   - 6-d. Servant classes

Of the six main groups shown above, three are subdivided, thus making a total of twelve groups. In a given study, the six main groups, the entire twelve groups, or any combination of the main and the sub-groups may be used, and still have comparability with the statistics here presented for the United States.

In Table 1 the specific occupations of the 1930 classification, with the United States totals for each occupation, are so rearranged as to make up the twelve social-economic groups. In Table 2 the twelve groups are presented, by sex, for 1910, 1920, and 1930, the earlier census data having been revised to conform with the 1930 classification.

TABLE 1

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX AND OCCUPATION: 1930

Group and occupation	Male	Female
All gainful workers	38,077,804	10,752,116
1. PROFESSIONAL PERSONS	1,497,934	1,447,863
Actors and showmen	54,511	20,785
Architects	21,621	379
Artists, sculptors, and teachers of art	35,621	21,644
Authors, editors, and reporters	46,922	17,371
Chemists, assayers, and metallurgists	45,163	1,905
Clergymen	145,572	3,276
College presidents and professors	41,774	20,131
Dentists	69,768	1,287
Designers, draftsmen, and inventors	93,518	9,212
Lawyers, judges, and justices	157,220	3,385
Musicians and teachers of music	85,517	79,611
Osteopaths	4,554	1,563
Photographers	31,163	8,366
Physicians and surgeons	146,978	6,825
Teachers	202,337	860,278
Technical engineers	226,136	113
Trained nurses	5,452	288,737
Veterinary surgeons	11,852	11
Other professional pursuits	43,847	70,546
Chiropractors	9,203	2,713
Healers (not elsewhere classified)	7,866	9,774
Religious workers	11,339	19,951
2. PROPRIETORS, MANAGERS, AND OFFICIALS	9,159,896	505,644
2-a Farmers (owners and tenants)	5,749,367	262,645
2-b Wholesale and retail dealers	1,675,193	111,854
Retail dealers	1,593,356	110,166
Wholesale dealers, importers, and exporters	81,837	1,688
2-c Other proprietors, managers, and officials	1,735,336	131,145
Foresters, forest rangers, and timber cruisers	8,042	15
Owners and managers of log and timber camps	6,889	10
Operators, managers, and officials - Extraction of minerals	30,755	141
Builders and building contractors	167,310	202
Manufacturers	202,190	5,711
Managers and officials - Manufacturing	302,334	10,422
Captains, masters, mates, and pilots	24,482	3
Garage owners, managers, and officials	69,543	422
Owners and managers - Truck, transfer, and cab companies	40,508	576
Conductors - Steam railroad	73,332	--
Officials and superintendents - Steam and street railroads	37,963	26
Postmasters	20,818	13,603
Proprietors, managers, and officials* - Transportation	34,987	3,003
Bankers, brokers, and money lenders	212,312	9,192
Managers and officials - Insurance companies	87,556	1,752
Proprietors, managers, and officials* - Trade	42,201	3,104
Managers and officials - Real estate companies	5,124	479
Undertakers	32,192	1,940
Officials and inspectors - City and county	69,431	8,964
Officials and inspectors - State and United States	49,681	1,819
Billiard room, dance hall, etc., keepers	28,819	310
Directors, managers, and officials - Motion picture production	1,888	35
Keepers of charitable and penal institutions	9,468	5,552
Keepers of pleasure resorts, race tracks, etc.	9,741	977
Radio announcers, directors, managers, etc.	1,639	180
Theatrical owners, managers, and officials	18,691	1,052

TABLE 1

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX AND OCCUPATION: 1930, *Continued*

Group and occupation	Male	Female
2-c Other proprietors, managers, and officials, Contd		
Owners and proprietors - Cleaning, dyeing, and pressing shops	15,207	1,068
Managers and officials - Cleaning, dyeing, and pressing shops	4,615	1,226
Hotel keepers and managers	39,538	17,310
Laundry owners, managers, and officials	22,482	2,063
Restaurant, cafe, and lunch room keepers	125,398	40,008
3. CLERKS AND KINDRED WORKERS	4,877,235	3,072,220
Inspectors, scalers, and surveyors - Log and timber camps	2,183	1
Baggagemen and freight agents - Railroad	16,361	16
Ticket and station agents - Railroad	25,370	1,790
Agents - Express companies	4,102	74
Express messengers and railway mail clerks	25,600	6
Mail carriers	120,204	1,129
Radio operators	4,909	46
Telegraph messengers	15,997	179
Telegraph operators	51,699	16,122
Telephone operators	13,625	235,259
Advertising agents	43,364	5,656
"Clerks" in stores	238,844	163,147
Commercial travelers	219,790	3,942
Decorators, drapers, and window dressers	13,911	6,258
Inspectors, gaugers, and samplers - Trade	10,923	5,820
Insurance agents	243,974	12,953
Newsboys	38,576	417
Real estate agents	203,119	31,308
Salesmen and saleswomen	1,508,283	560,720
Abstracters, notaries, and justices of peace	9,848	1,908
Architects', designers', and draftsmen's apprentices	2,436	220
Apprentices to other professional persons	3,861	74
Officials of lodges, societies, etc.	11,513	3,002
Technicians and laboratory assistants	8,288	7,700
Dentists' assistants and attendants	770	12,945
Librarians' assistants and attendants	502	1,363
Physicians' and surgeons' attendants	689	13,353
Agents, collectors, and credit men	182,630	13,477
Bookkeepers, cashiers, and accountants	447,937	482,711
Clerks (except "clerks" in stores)	1,290,447	706,553
Messenger, errand, and office boys and girls	81,430	8,949
Stenographers and typists	36,050	775,140
4. SKILLED WORKERS AND FOREMEN	6,201,542	81,145
Farm managers and foremen	66,259	963
Foremen - Log and timber camps	3,910	--
Foremen, overseers, and inspectors - Extraction of minerals	34,274	12
Blacksmiths, forgemen, and hammermen	147,460	9
Boilermakers	49,923	--
Brick and stone masons and tile layers	170,896	7
Cabinetmakers	57,890	7
Carpenters	929,376	50
Compositors, linotypers, and typesetters	173,363	10,269
Coopers	11,347	--
Electricians	260,279	38
Electrotypers, stereotypers, and lithographers	16,448	244
Engineers (stationary), oranemen, hoistmen, etc.	316,942	22
Engravers	18,747	690
Foremen and overseers - Manufacturing	310,037	28,467
Puddlers	1,597	--
Glass blowers	3,209	59
Jewelers, watchmakers, goldsmiths, and silversmiths	37,408	1,254
Loom fixers	19,180	35
Machinists, millwrights, and toolmakers	761,075	20
Mechanics*	638,190	63
Millers (grain, flour, feed, etc.)	15,906	40

TABLE 1

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX AND OCCUPATION: 1930, *Continued*

Group and occupation	Male	Female
4. SKILLED WORKERS AND FOREMEN, Continued		
Molders, founders, and casters (metal)	105,139	19
Painters, glaziers, and varnishers (building)	429,982	123
Paper hangers	26,872	1,456
Pattern and model makers	29,711	39
Piano and organ tuners	6,799	24
Plasterers and cement finishers	85,477	3
Plumbers and gas and steam fitters	237,813	1
Pressmen and plate printers (printing)	31,215	--
Rollers and roll hands (metal)	30,765	--
Roofers and slaters	23,636	--
Sawyers	35,984	80
Shoemakers and cobblers (not in factory)	76,127	261
Skilled occupations (not elsewhere classified)	12,227	31
Stonecutters	22,887	1
Structural iron workers (building)	28,966	--
Tailors and tailoresses	147,476	21,807
Tinsmiths and coppersmiths	83,421	6
Upholsterers	49,097	2,355
Bus conductors	1,002	--
Conductors - Street railroad	35,680	17
Foremen and overseers - Steam and street railroads	79,682	55
Locomotive engineers	101,201	--
Locomotive firemen	67,096	--
Aviators	6,031	66
Foremen and overseers* - Transportation	52,061	74
Inspectors - Transportation	50,965	1,155
Floorwalkers, foremen, and overseers - Trade	33,368	4,795
Firemen - Fire department	73,008	--
Marshals, sheriffs, detectives, etc.	39,247	2,576
Policemen	130,838	849
Foremen and overseers - Cleaning, dyeing, and pressing shops	470	349
Foremen and overseers - Laundries	3,583	2,754
5. SEMISKILLED WORKERS	5,448,158	2,529,414
5-a Semiskilled workers in manufacturing	2,881,022	1,676,971
Apprentices to building and hand trades	40,105	28
Apprentices (except to building and hand trades) - Manufacturing	33,450	3,869
Bakers	131,884	8,916
Dressmakers and seamstresses (not in factory)	452	157,928
Dyers	17,425	294
Filers, grinders, buffers, and polishers (metal)	76,264	2,336
Milliners and millinery dealers	4,846	40,102
Oilers of machinery	31,169	41
Enamelers, lacquerers, and japanners	4,622	1,136
Painters, glaziers, and varnishers (factory)	89,546	3,522
Operatives* - Manufacturing	2,451,259	1,458,799
5-b Other semiskilled workers	2,567,136	852,443
Boatmen, canal men, and lock keepers	5,603	40
Sailors and deck hands	64,692	8
Chauffeurs and truck and tractor drivers	970,916	1,502
Boiler washers and engine hostlers	18,300	--
Brakemen - Steam railroad	88,197	--
Motormen - Steam and street railroads	60,718	5
Switchmen, flagmen, and yardmen - Steam and street railroads	102,484	289
Telegraph and telephone linemen	71,624	1
Apprentices - Transportation	6,097	54
Other occupations - Transportation	83,794	1,923
Apprentices - Wholesale and retail trade	2,337	107
Deliverymen- Bakeries and stores	159,328	116
Other pursuits in trade	96,069	29,106

TABLE 1

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX AND OCCUPATION: 1930, *Continued*

Group and occupation	Male	Female
5-b Other semiskilled workers, Continued		
Guards, watchmen, and doorkeepers	147,115	1,000
Soldiers, sailors, and marines	132,830	--
Other public service pursuits	40,369	1,268
Other occupations - Professional service	8,765	1,756
Attendants - Pool rooms, bowling alleys, golf clubs, etc.	16,047	121
Helpers - Motion picture production	1,234	979
Theater ushers	9,308	3,153
Other attendants and helpers - Professional service	28,890	21,480
Barbers, hairdressers, and manicurists	261,096	113,194
Boarding and lodging house keepers	17,093	127,278
Other operatives - Cleaning, dyeing, and pressing shops	42,313	18,321
Housekeepers and stewards	20,383	236,363
Deliverymen - Laundries	20,558	15
Other operatives - Laundries	45,087	149,414
Midwives and nurses (not trained)	13,867	143,142
Other pursuits - Domestic and personal service	32,022	1,808
6. UNSKILLED WORKERS	10,893,039	3,115,830
6-a Farm laborers	3,746,433	646,331
6-b Factory and building construction laborers	3,248,622	125,521
Firemen (except locomotive and fire department)	127,293	1
Furnace men, smelter men, and pourers	18,627	--
Heaters (metal)	14,941	1
Laborers* - Manufacturing	3,087,761	125,519
6-c Other laborers	2,871,744	31,321
Fishermen and oystermen	73,071	209
Teamsters and haulers - Log and timber camps	9,242	1
Other lumbermen, raftsmen, and woodchoppers	146,803	93
Coal mine operatives	621,545	116
Other operatives in extraction of minerals	296,990	490
Longshoremen and stevedores	73,944	10
Draymen, teamsters, and carriage drivers	111,178	46
Garage laborers	66,536	157
Hostlers and stable hands	6,654	--
Laborers - Truck, transfer, and cab companies	40,920	50
Laborers - Road and street	306,980	47
Laborers, including construction laborers - Steam and street railroads	459,090	3,384
Laborers* - Transportation	50,998	65
Laborers in coal and lumber yards, warehouses, etc.	113,027	642
Laborers, porters, and helpers in stores	199,296	9,392
Laborers - Public service	155,903	1,107
Laborers - Professional service	23,762	1,621
Laborers - Recreation and amusement	29,458	435
Stage hands and circus helpers	4,099	175
Laborers - Cleaning, dyeing, and pressing shops	3,910	639
Laborers - Domestic and personal service	67,337	4,350
Laborers - Laundries	11,001	8,292
6-d Servant classes	1,026,240	2,312,657
Bootblacks	18,747	37
Charwomen and cleaners	20,943	40,989
Elevator tenders	55,255	12,359
Janitors and sextons	273,805	35,820
Launderers and laundresses (not in laundry)	4,565	356,468
Porters (except in stores)	127,436	52
Servants	364,174	1,634,959
Waiters	161,315	231,973

* Not otherwise specified

TABLE 2

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX: 1910 TO 1930

Census year and group	Total		Male		Female	
	Number	Per cent	Number	Per cent	Number	Per cent
1930	48,829,920	100.0	38,077,804	100.0	10,752,116	100.0
1. PROFESSIONAL PERSONS	2,945,797	6.0	1,497,934	3.9	1,447,863	13.5
2. PROPRIETORS, MANAGERS, AND OFFICIALS	9,665,540	19.8	9,159,896	24.1	505,644	4.7
2-a Farmers (owners and tenants)	6,012,012	12.3	5,749,367	15.1	262,645	2.4
2-b Wholesale and retail dealers	1,787,047	3.7	1,675,193	4.4	111,854	1.0
2-c Other proprietors, managers, and officials	1,866,481	3.8	1,735,336	4.6	131,145	1.2
3. CLERKS AND KINDRED WORKERS	7,949,455	16.3	4,877,235	12.8	3,072,220	28.6
4. SKILLED WORKERS AND FOREMEN	6,282,687	12.9	6,201,542	16.3	81,145	0.8
5. SEMISKILLED WORKERS	7,977,572	16.3	5,448,158	14.3	2,529,414	23.5
5-a Semiskilled workers in manufacturing	4,557,993	9.3	2,881,022	7.6	1,676,971	15.6
5-b Other semiskilled workers	3,419,579	7.0	2,567,136	6.7	852,443	7.9
6. UNSKILLED WORKERS	14,008,869	28.7	10,893,039	28.6	3,115,830	29.0
6-a Farm laborers	4,392,764	9.0	3,746,433	9.8	646,331	6.0
6-b Factory and building construction laborers	3,374,143	6.9	3,248,622	8.5	125,521	1.2
6-c Other laborers	2,903,065	5.9	2,871,744	7.5	31,321	0.3
6-d Servant classes	3,338,897	6.8	1,026,240	2.7	2,312,657	21.5
1920	41,614,248	100.0	33,064,737	100.0	8,549,511	100.0
1. PROFESSIONAL PERSONS	2,050,162	4.9	1,061,791	3.2	988,371	11.6
2. PROPRIETORS, MANAGERS, AND OFFICIALS	9,180,583	22.1	8,757,614	26.5	422,969	4.9
2-a Farmers (owners and tenants)	6,387,360	15.3	6,121,783	18.5	265,577	3.1
2-b Wholesale and retail dealers	1,401,849	3.4	1,322,075	4.0	79,774	0.9
2-c Other propra, mgrs, and off.	1,391,374	3.3	1,313,756	4.0	77,618	0.9
3. CLERKS AND KINDRED WORKERS	5,704,970	13.7	3,511,808	10.6	2,193,162	25.7
4. SKILLED WORKERS AND FOREMEN	5,570,602	13.4	5,469,048	16.5	101,554	1.2
5. SEMISKILLED WORKERS	6,638,615	16.0	4,375,995	13.2	2,262,620	26.5
5-a Semiskilled workers in mfg.	4,357,451	10.5	2,689,245	8.1	1,668,206	19.5
5-b Other semiskilled workers	2,281,164	5.5	1,686,750	5.1	594,414	7.0
6. UNSKILLED WORKERS	12,469,316	30.0	9,888,481	29.9	2,580,835	30.2
6-a Farm laborers	4,186,128	10.1	3,382,899	10.2	803,229	9.4
6-b Factory & bldg cstn laborers	3,136,276	7.5	2,966,841	9.0	169,435	2.0
6-c Other laborers	2,890,738	6.9	2,859,343	8.6	31,395	0.4
6-d Servant classes	2,256,174	5.4	679,398	2.1	1,576,776	18.4
1910	38,167,336	100.0	30,091,564	100.0	8,075,772	100.0
1. PROFESSIONAL PERSONS	1,632,638	4.3	913,866	3.3	718,772	8.9
2. PROPRIETORS, MANAGERS, AND OFFICIALS	8,479,746	22.2	8,083,563	26.9	396,183	4.9
2-a Farmers (owners and tenants)	6,132,380	16.1	5,859,238	19.5	273,142	3.4
2-b Wholesale and retail dealers	1,246,077	3.3	1,178,049	3.9	68,028	0.8
2-c Other propra, mgrs, and off.	1,101,289	2.9	1,046,276	3.5	55,013	0.7
3. CLERKS AND KINDRED WORKERS	3,826,959	10.0	2,744,488	9.1	1,082,471	13.4
4. SKILLED WORKERS AND FOREMEN	4,464,060	11.7	4,367,327	14.5	96,733	1.2
5. SEMISKILLED WORKERS	5,512,344	14.4	3,326,830	11.1	2,185,514	27.1
5-a Semiskilled workers in mfg.	3,674,302	9.6	2,032,346	6.8	1,641,956	20.3
5-b Other semiskilled workers	1,838,042	4.8	1,294,484	4.3	543,558	6.7
6. UNSKILLED WORKERS	14,251,589	37.3	10,655,490	35.4	3,596,099	44.5
6-a Farm laborers	6,205,633	16.3	4,679,926	15.6	1,525,707	18.9
6-b Factory & bldg cstn laborers	2,659,917	7.0	2,571,215	8.5	88,702	1.1
6-c Other laborers	2,821,526	7.4	2,803,596	9.3	17,930	0.2
6-d Servant classes	2,564,513	6.7	600,753	2.0	1,963,760	24.3

According to Table 2, in 1930 almost 1 gainful worker in 16 was a professional person, and almost 1 in 5 was a proprietor, manager, or official. Clerks and kindred workers, frequently referred to as "white-collar workers," accounted for nearly 1 worker in 6. More than 1 worker in 8 was skilled, nearly 1 in 6 was semiskilled, and considerably over 1 in 4 was unskilled. These last three groups combined constitute the manual workers. To distinguish them from the "white-collar workers," they may appropriately be called the "overalls and apron workers." Together, they numbered, in 1930, considerably over one-half (57.9 per cent) of all gainful workers.

During the 20-year period from 1910 to 1930, there were some significant changes in the distribution of the gainful workers among the twelve social-economic groups shown in Table 2. Farmers decreased strikingly from 16.1 to 12.3 per cent of the total, and farm laborers from 16.3 to 9 per cent. There was a slight decrease in the proportion classed as semiskilled workers in manufacturing, in the proportion classed as factory and building construction laborers, and in the proportion classed as "Other laborers." While the proportion of the total in each of the other seven groups increased during the 20-year period, the increase was marked only in the case of the clerical group—from 10 per cent in 1910 to 16.3 per cent in 1930.

At each census the distribution of female gainful workers by social-economic groups has differed considerably from that of male workers. As compared with the corresponding proportion for males, the proportion of the females in the professional group, in the clerical group, in the semiskilled group, and in the servant group, is particularly large; and the proportion in the proprietary, official, and managerial group, in the skilled-worker group, and in the different laborer groups is particularly small. There was a very striking increase between 1910 and 1930 in the proportion of female workers engaged in clerical and kindred pursuits, a marked decrease in the proportion employed as semiskilled factory workers and as agricultural laborers, and a considerable decrease in the proportion employed as servants.

The most significant changes between 1910 and 1930 in the distribution of the male workers were the decrease in the proportion farmers formed of the total, from 19.5 per cent to 15.1 per cent, and the decrease in the proportion farm laborers formed of the total, from 15.6 per cent to 9.8 per cent.

Table 3 shows for native whites, foreign-born whites, and Negroes, the gainful workers in 1930 classified into social-economic groups, by sex.

TABLE 3

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY COLOR, NATIVITY, AND SEX: 1930

Population class and group	Total		Male		Female	
	Number	Per cent	Number	Per cent	Number	Per cent
NATIVE WHITE	35,173,370	100.0	27,511,862	100.0	7,661,508	100.0
1. PROFESSIONAL PERSONS	2,532,206	7.2	1,243,081	4.5	1,289,125	16.8
2. PROPRIETORS, MANAGERS, AND OFFICIALS	7,370,028	21.0	7,017,203	25.5	352,825	4.6
2-a Farmers (owners and tenants)	4,598,201	13.1	4,435,418	16.1	162,783	2.1
2-b Wholesale and retail dealers	1,248,518	3.5	1,169,058	4.2	79,460	1.0
2-c Other proprietors, managers, and officials	1,523,309	4.3	1,412,727	5.1	110,582	1.4
3. CLERKS AND KINDRED WORKERS	7,103,717	20.2	4,262,882	15.5	2,840,835	37.1
4. SKILLED WORKERS AND FOREMEN	4,688,661	13.3	4,623,705	16.8	64,956	0.8
5. SEMISKILLED WORKERS	5,787,380	16.5	3,886,352	14.1	1,901,028	24.8
5-a Semiskilled workers in manufacturing	3,256,427	9.3	1,958,928	7.1	1,297,499	16.9
5-b Other semiskilled workers	2,530,953	7.2	1,927,424	7.0	603,529	7.9
6. UNSKILLED WORKERS	7,691,378	21.9	6,478,639	23.5	1,212,739	15.8
6-a Farm laborers	2,863,482	8.1	2,659,897	9.7	203,585	2.7
6-b Factory and building construction laborers	1,861,660	5.3	1,774,693	6.5	86,967	1.1
6-c Other laborers	1,690,938	4.8	1,672,688	6.1	18,250	0.2
6-d Servant classes	1,275,298	3.6	371,361	1.3	903,937	11.8
FOREIGN-BORN WHITE	7,411,127	100.0	6,255,071	100.0	1,156,056	100.0
1. PROFESSIONAL PERSONS	287,243	3.9	191,781	3.1	95,462	8.3
2. PROPRIETORS, MANAGERS, AND OFFICIALS	1,263,289	17.0	1,201,688	19.2	61,601	5.3
2-a Farmers (owners and tenants)	468,322	6.3	447,205	7.1	21,117	1.8
2-b Wholesale and retail dealers	493,431	6.7	466,059	7.5	27,372	2.4
2-c Other proprs, mgrs, and off.	301,536	4.1	288,424	4.6	13,112	1.1
3. CLERKS AND KINDRED WORKERS	731,204	9.9	528,593	8.5	202,611	17.5
4. SKILLED WORKERS AND FOREMEN	1,381,971	18.6	1,367,463	21.9	14,508	1.3
5. SEMISKILLED WORKERS	1,594,471	21.5	1,180,294	18.9	414,177	35.8
5-a Semiskilled workers in mfg.	1,082,214	14.6	797,648	12.8	284,566	24.6
5-b Other semiskilled workers	512,257	6.9	382,646	6.1	129,611	11.2
6. UNSKILLED WORKERS	2,152,949	29.1	1,785,252	28.5	367,697	31.8
6-a Farm laborers	199,579	2.7	194,358	3.1	5,221	0.5
6-b Factory & bldg cstn laborers	750,640	10.1	737,108	11.8	13,532	1.2
6-c Other laborers	591,005	8.0	586,448	9.4	4,557	0.4
6-d Servant classes	611,725	8.3	267,338	4.3	344,387	29.8
NEGRO	5,503,535	100.0	3,662,893	100.0	1,840,642	100.0
1. PROFESSIONAL PERSONS	115,765	2.1	55,610	1.5	60,155	3.3
2. PROPRIETORS, MANAGERS, AND OFFICIALS	929,644	16.9	842,920	23.0	86,724	4.7
2-a Farmers (owners and tenants)	873,653	15.9	797,231	21.8	76,422	4.2
2-b Wholesale and retail dealers	28,343	0.5	24,493	0.7	3,850	0.2
2-c Other proprs, mgrs, and off.	27,648	0.5	21,196	0.6	6,452	0.4
3. CLERKS AND KINDRED WORKERS	82,669	1.5	62,138	1.7	20,531	1.1
4. SKILLED WORKERS AND FOREMEN	176,912	3.2	175,537	4.8	1,375	0.1
5. SEMISKILLED WORKERS	515,381	9.4	329,374	9.0	186,007	10.1
5-a Semiskilled workers in mfg.	181,079	3.3	104,441	2.9	76,638	4.2
5-b Other semiskilled workers	334,302	6.1	224,933	6.1	109,369	5.9
6. UNSKILLED WORKERS	3,683,164	66.9	2,197,314	60.0	1,485,850	80.7
6-a Farm laborers	1,112,510	20.2	693,669	18.9	418,841	22.8
6-b Factory & bldg cstn laborers	674,187	12.3	650,925	17.8	23,262	1.3
6-c Other laborers	516,414	9.4	508,754	13.9	7,660	0.4
6-d Servant classes	1,380,053	25.1	343,966	9.4	1,036,087	56.3

The six main occupation groups shown in Table 3 are arranged, approximately at least, in descending order of the social-economic status of the workers in them. Hence the percentage distribution of the workers among these six main groups, as presented in Column 2, furnishes a convenient basis for comparing the social-economic status of the workers in the different population classes in 1930. A larger percentage of the native whites than of the foreign-born whites was in each of the first three main groups and a much smaller percentage was in each of the last three. The percentage, both of native whites and of foreign-born whites, was larger than that of Negroes in each main group except "Unskilled workers," where the percentage was over three times as large for Negroes as for native whites and considerably over twice as high for Negroes as for foreign-born whites. More than 2 out of 3 Negro workers in 1930 were unskilled; and the proportions of the Negro workers in the semiskilled group, in the skilled group, and in the clerical group were very small as compared with the corresponding proportions for native whites and foreign-born whites.

In 1930, 48.3 per cent of the native white workers, 30.8 per cent of the foreign-born white workers, and 20.5 per cent of the Negro workers were in the first three main groups—the groups comprising the "head workers." In contrast, 51.7 per cent of the native white workers, 69.2 per cent of the foreign-born white workers, and 79.5 per cent of the Negro workers were in the last three main groups—the groups comprising the "hand workers."

Possibly the relative proportions of the workers of the different population classes in the first three main groups of Table 3 may be accepted as a rough measure of the relative social-economic status of the different population classes in 1930. If so, the social-economic status of foreign-born whites was 63.6 per cent as high as that of native whites, and the social-economic status of Negroes was 42.4 per cent as high as that of native whites.

If, in Table 3, group 1 be combined with 2, 3 with 4, and 5 with 6, then it develops that, in 1930, 28.2 per cent of the native white workers, 20.9 per cent of the foreign-born white workers, and 19 per cent of the Negro workers were professional persons, proprietors, managers, or officials. Clerks and kindred workers, skilled workers, and foremen together formed 33.5 per cent of the native white workers, 28.5 per cent of the foreign-born white workers, and 4.7 per cent of the Negro workers. Semiskilled and unskilled workers combined constituted 38.3 per cent of the native white workers, 50.6 per cent of the foreign-born white workers, and 76.3 per cent of the Negro workers.

The relatively large proportion of the Negro workers classed as "Proprietors, managers, and officials" is explained by the fact that 15.9 per cent of the Negroes, as compared with 13.1 per cent of the native whites and 6.3 per cent of the foreign-born whites, were farmers (owners or tenants).

The distribution of the male gainful workers of the different population classes by social-economic status is very similar to the corresponding distribution of the total gainful workers, above discussed.

The proportion of the total female workers engaged in professional pursuits in 1930 was over twice as high for native whites as for foreign-born whites, and over five times as high for native whites as for Negroes. Likewise, the proportion engaged in clerical and kindred pursuits was over twice as high for native whites as for foreign-born whites and nearly thirty-four times as high for native whites as for Negroes. The proportion engaged in semiskilled occupations was highest for foreign-born whites, next highest for native whites, and lowest for Negroes. The proportion engaged in unskilled occupations was over twice as high for foreign-born whites as for native whites, and was over five times as high for Negroes as for native whites.

Professional persons, proprietors, managers, and officials together formed 21.4 per cent of the native white female workers, 13.6 per cent of the foreign-born white female workers, and 8 per cent of the Negro female workers, in 1930. Clerks and kindred workers, skilled workers, and foremen combined constituted 37.9 per cent of the native white female workers, 18.8 per cent of the foreign-born white female workers, and 1.2 per cent of the Negro female workers. Semiskilled and unskilled workers together accounted for 40.6 per cent of the native white female workers, 67.6 per cent of the foreign-born white female workers, and 90.8 per cent of the Negro female workers. The different servant occupations gave employment to 56.3 per cent of the Negro female workers, in 1930, and 22.8 per cent of them were agricultural laborers.

The foregoing discussion and the statistics presented therewith relate to the United States as a whole. The gainful workers of any state or any city of 100,000 or more can be grouped in accordance with the social-economic classification, however, on the basis of the census data on occupations.[1] Both state and city figures are given in Table 4 of the State Bulletin on Occupations—or of the state section in Volume IV of the Fifteenth Census Reports on Population.

[1] Census occupation statistics are presented for 1930, 1920, and 1910, in Table 1, Ch. 1, of Vol. V of the Fifteenth Census Reports on Population. The 1930 statistics are presented by color and nativity in Table 13 of the United States Summary on Occupations; in Table 13 of the United States section of Vol. IV; and in Table 3, Ch. 3, of Vol. V of the Fifteenth Census Reports on Population.

A STATISTICAL METHOD FOR ESTIMATING THE DISTRIBUTION OF SIZES OF COMPLETED FRATERNITIES IN A POPULATION REPRESENTED BY A RANDOM SAMPLING OF INDIVIDUALS [1]

By Barbara S. Burks, *Institute of Child Welfare, University of California*

In studies of birth trends and differential fertility it is often desirable but difficult to secure data upon the distribution of sizes or upon the average size of completed families. A method is herewith presented for estimating this distribution and average size for the total population from which a sample of individuals belonging to fraternities of varying completeness is drawn. Formulae are presented for the standard errors of estimate; several illustrations of application to data are given; and a check of the method against fact is provided through material involving 1,800 fraternities complete or approximately so.

We take a random group of individuals from the population to be studied and ascertain their birth orders.[2] It is desirable that these individuals should be within a few years of one another in age so that changing birth rates, differential age mortality, and other factors will not introduce complications. Our problem is to find the distribution of sizes of ultimately completed fraternities which would yield the composition of birth orders found in our sample. Let the number of fraternities which will be completed with one child, two children, n children, etc., be proportional to $\varphi(1)$, $\varphi(2)$, $\varphi(n)$. Let $N(\nu)$ equal the number of children in our sample of given birth order, ν.

Since fraternities of given completed size tend to produce during any period equal numbers of children of each birth order they contain, then, even though these fraternities in the sample vary in completeness, the several birth orders will stand equal chances of being "caught." This means that

$$(1) \qquad N(n)=\varphi(n)+\varphi(n+1)+\varphi(n+2) \ . \ . \ .$$

or, in detail, our sample will contain,

[1] Acknowledgment is made to Dr. J. R. Oppenheimer, Dr. Harold E. Jones, Dr. Herbert S. Conrad, and Dr. Sidney Adams, who read and criticized the manuscript. The author is greatly indebted to Dr. Oppenheimer for his derivations of two formulae for standard errors, (6) and (7).

[2] The selection of *individuals* must be random within the group defined; it would not be permissible to take all of the offspring of a random set of families. It is preferable to find the actual birth orders with respect to all siblings, living and dead, but if this is not possible, corrections for mortality can later be made.

$$
\begin{array}{lll}
\text{1st born children,} & \varphi(1)+\varphi(2)+\varphi(3)\ \ldots\ +\varphi(l-1)+\varphi(l)=N(1) & \\
\text{2nd born children,} & \varphi(2)+\varphi(3)\ \ldots\ +\varphi(l-1)+\varphi(l)=N(2) & \\
\text{(1a) 3rd born children,} & \varphi(3)\ \ldots\ +\varphi(l-1)+\varphi(l)=N(3) & \\
\ldots\ldots\ldots\ldots\ldots\ldots & \ldots\ldots\ldots\ldots\ldots\ldots & \\
(l-1)^{th}\text{ born children,} & \varphi(l-1)+\varphi(l)=N(l-1) & \\
l^{th}\text{ born children,} & \varphi(l)=N(l) &
\end{array}
$$

We have supposed for simplicity in work that φ is zero for $n>l$, i.e., that in our sample no families appear with more than l children.

Solving, we get

$$\varphi(n)=\delta N(n) \qquad \text{where} \tag{2}$$

$$\delta N(n)=N(n)-N(n+1) \tag{3}$$

This is the solution of our problem. The proportional number of fraternities of given n is the difference in the number of children of birth order n and the number of birth order $n+1$. To obtain the percentage distribution it is of course necessary only to divide each $\varphi(n)$ by $\sum_1^l \varphi(n)$, which is simplified by the fact, from (1a), that

$$\sum_1^l \varphi(n)=N(1) \tag{4}$$

It is not out of place to mention here a point which has caused intermittent concern in population studies. It has sometimes happened in tabulations of the distribution of fraternal sizes that no allowance has been made for the fact that an n-sized fraternity is n times as likely to be represented in any "drag-net" sample as a one-child fraternity. Disregard of this fact has caused the computed average size and the incidence of large fraternities to appear grotesquely high. With the present method, the necessary weighting for the size-selective incidence of fraternities is inherent, for fraternities of given size occur only once in our $\varphi(n)$ distribution, regardless of size. This is obvious from (1), (2) and (3).

The estimated average size, m, of completed fraternities is more frequently of interest than is the distribution of sizes, and is always to be determined with greater ease and with less error of estimate. When the average alone is desired it is not necessary to make a frequency distribution, $N(\nu)$, but only to ascertain the number of first born children in our sample. We may write, from (1a),

$$m=\frac{\sum_1^l n\varphi(n)}{\sum_1^l \varphi(n)}=\frac{N}{N(1)} \tag{5}$$

which means that the average size of the fraternities is given by the number of children divided by the number of families.

The standard error of estimate, σ, of the function m, and the standard error of estimate, S_n, of the function, $\varphi(n)$, have been derived by J. R. Oppenheimer. These are given by the following formulae:

$$(6) \quad \sigma/m = \sqrt{m-1/N}$$

$$(7) \quad S_n/\varphi(n) = N^{-\frac{1}{2}} \frac{\{p(n)\,[1-p(n)]+p(n+1)\,[1-p(n+1)]+2p(n)\,p(n+1)\}^{\frac{1}{2}}}{p(n)-p(n+1)}$$

APPLICATIONS TO CURRENT POPULATION STUDIES

(A) *Completed fraternities in United States Birth Registration Area.* The annual census report upon births [1] has included since 1917 a tabulation of birth orders. While there is lack of uniformity in reports from the several states, some including previous stillbirths in calculating birth orders and some including only previous live births, this matters little in fact, since stillbirths constitute only about 4 per cent of total births. Statistics for the year 1928 were chosen since such data would be useful to compare with some on hand for Berkeley. (Illustration B.) The data exclude 10,000 births for which birth order was unknown, and returns from five states not furnishing birth order statistics.

From Table I we may draw the interesting deduction that the one-child family now has an incidence higher than that of any other size. One-child and two-child families together account for 52 per cent of the total number. The estimated average size is 3.28 (standard error, .003) a number only slightly above that needed to maintain a stationary population in the face of child mortality and the infecundity of large groups not represented in a tabulation of fertile families.

Birth order data on 1,187,000 births ten years earlier yield an estimated average size of completed fraternities equal to 3.63 (standard error, .005). War time conditions of 1918 may have introduced certain errors into this estimate. However, the figure 3.63 differs very little from the average number of children per mother, 3.68, calculated by a different method by Dublin and Lotka from the conditions of maternity and mortality prevailing among white females in 1920.[2] Both averages

[1] *Birth, Stillbirth, and Infant Mortality Statistics.*

[2] L. I. Dublin and A. J. Lotka, "On the True Rate of Natural Increase," this JOURNAL, 1925, pp. 305–339. The calculation of these authors was incidental to a study of secular rate of increase, and depended upon the use of (a) census data on age composition of the total female population, of married women, and of women bearing children in 1920, and (b) life expectation tables giving the probability at birth of reaching the various ages of child bearing.

are doubtless a little lower than would have been the case if they had included certain fecund southern states which later were incorporated into the Birth Registration Area.

The Immigration Commission in its 1911 *Annual Report* furnished data upon the fecundity of Rhode Island, Ohio, and Minnesota urban and rural women who had been married ten to nineteen years at the time of the 1900 United States Census. The average number of offspring for all groups was 4.1; for native white of white parentage, 2.7; for foreign-born white, 4.7. These data, combined with our estimates of average fraternal size based on the 1918 and 1928 birth statistics, provide striking evidence of declining family size in this country.

(B) *Average size of completed fraternities in Berkeley, California.* A survey was made between January, 1928, and June, 1929, of families represented by every third child born in Berkeley during the period.[1] The total number of live births was 402, the number of first born children, 171, the estimated average size of completed fraternities, 2.4, with a standard error of estimate of .11. The average is seen to be only 73 per cent of that for the country at large in 1928.

(C) *Average size of completed fraternities of gifted school pupils in California.* The gifted subjects were studied by Lewis M. Terman in 1922.[2] On the basis of data from 91 families already complete (mothers over 45) at the time of the investigation, the average fraternal size was found to be 2.2. None of the gifted children, however, was over 13, and thus the 91 mothers were all over 32 when these children were born. As first children are usually born before their mothers are 32, the selection discriminated against one-child families.

Pregnancy orders (though not orders of live births) were available for 574 of the gifted subjects. Of these, 273 resulted from first pregnancies, 153 from second, 80 from third, 36 from fourth, and the remainder from higher orders. The percentage of miscarriage in the pregnancies of this group of mothers (exclusive of the pregnancies of the propositus children) was 17.4. Making the assumption (approximately true) that the miscarriage rate was constant for the orders of pregnancy involved, we estimate that .174 of the second pregnancy subjects were actually first born $(.174)^2$ of the third pregnancy subjects, and $(.174)^3$ of the fourth pregnancy subjects. We must therefore add 30.2 to the 273 cases of first pregnancies to get the probable number of first born.

[1] Part of a large-scale investigation conducted by the Institute of Child Welfare, University of California.

[2] L. M. Terman et al., *Mental and Physical Traits of a Thousand Gifted Children*, Stanford, 1926 (2nd ed.), pp. 113 ff.

TABLE I

DISTRIBUTION OF ESTIMATED COMPLETED FRATERNITIES IN THE UNITED STATES BIRTH REGISTRATION AREA*

ν, Birth order n, Completed size	$N(\nu)$ Children born in 1928	$\phi(n)$ Completed fraternities	$\phi(n)/N(1)$ Percentage of completed fraternities
1	635,820	183,437	28.8
2	452,383	148,873	23.4
3	303,510	96,058	15.1
4	207,452	62,659	9.9
5	144,793	40,346	6.3
6	104,447	28,229	4.4
7	76,218	20,551	3.2
8	55,667	16,961	2.7
9	38,706	11,562	1.8
10	27,144	10,197	1.6
11	16,947	6,312	1.0
12	10,635	4,593	0.7
13	6,042	2,625	0.4
14	3,417	1,662	0.3
15	1,755	848	0.1
16	907	438	
17	469	198	
18	271	132	
19	139	61	
20	78	52	
21	26	8	0.1
22	18	0	
23	18	7	
24	11	5	
25	6	3	
26	3	3	
Sum	2,086,882	635,820	99.8

Estimated average size, $m=2,086,882/635,820=3.28$
Standard error of estimate, $\sigma=0.003$

* Based upon birth orders reported for 1928 in *Birth, Stillbirth and Infant Mortality Statistics*. Excluded were births from five states not reporting upon birth orders, and 10,000 additional cases for which birth order was unknown.

$$m=\frac{574}{303.2}=1.9$$

$$\sigma= \qquad .08$$

(D) *Estimated and actual completed sizes of fraternities of college students.* Data on family order and fraternal size of 1,800 University of California students enrolled in elementary psychology classes between the years of 1924 and 1929 were made available through the courtesy of Professor George M. Stratton. The material and estimates here refer only to surviving offspring. The students were all in the second year of college or above; nearly all, therefore, were over 18 years of age, and it may be assumed that practically all their fraternities were complete. In Table II are tabulated the essential data and results for this group.

When checking the estimated sizes against the actual sizes of completed fraternities we must recall the fact (mentioned p. 389) that an n-sized fraternity is n times as likely to be represented in any "drag-

net" sample of offspring as a one-child fraternity; that small families are thereby selected against. This fact is allowed for in the method of estimate developed in the present paper; hence column 3 of Table II gives the estimated percentage distribution of fraternal size in the stratum of fertile families *represented* by the students, though not in the families of the students themselves. To find the proportional distribution of sizes of actually complete fraternities in the stratum of population from which the students are drawn, it is first necessary to weight the fraternal size-class frequencies of column 4. The frequency $\varphi'(2)$ of two-child fraternities must be divided by two, the frequency $\varphi'(3)$ of three-child fraternities by three, . . . the frequency $\varphi'(n)$ of n-child fraternities by n. From the resulting weighted frequencies, the percentage incidence in each size-class of completed fraternities is then calculated (column 5 of Table II).

From the figures in Table II it is seen that the agreement between estimated average size and actual average size in the stratum represented by the students is exact to the first decimal place. The distributions of sizes, too, show agreement as close as the errors of estimate would lead us to expect. The estimated proportion of completed one-child families, 42.9, which shows the largest absolute (though not relative) discrepancy from the actual proportion, has a standard error of 4.3 by formula (7).

As a check upon the derived formulae for standard errors of estimate, the data for the 1,800 students were shuffled into 18 random groups of 100 each. The relative standard deviations were computed for the distributions of m, $\varphi(1)$, $\varphi(3)$, and $\varphi(7)$ in the 18 samples, and compared with those required by the formulae. The following result gives as good agreement as we could expect from the limited number of samples:

	Computed from 18 samples of $N=100$	Calculated by formula for $N=100$
σ/m	.10	.11
$S_1/\varphi(1)$	.43	.39
$S_3/\varphi(3)$	.59	.49
$S_7/\varphi(7)$	1.37	1.45

SOURCES OF ERROR

The estimates of fraternal size distribution would be completely valid only in a population that was stationary with respect to fraternal size and age composition of married individuals. It is because these factors are often in flux that it is important when making estimates to choose a population sample within a narrow age range. But even if the individuals of our sample are of exactly the same age, their frater-

TABLE II

COMPARISON OF ESTIMATED AND ACTUAL DISTRIBUTIONS OF COMPLETED FRATERNITIES IN A GROUP OF 1,800 COLLEGE STUDENTS

(1) ν, Family order n, Completed size	(2) $N(\nu)$ College students	(3) $\varphi(n)/N(1)$ Percentage of estimated completed fraternities	(4) $\varphi'(n)$ Completed fraternities in sample	(5) $\varphi'(n)/n\Sigma\frac{\varphi'(n)}{n}$ Weighted percentage distribution of completed fraternities
1	797	42.9	275	35.5
2	455	23.8	457	29.5
3	265	17.6	440	18.9
4	125	7.2	247	8.0
5	68	3.9	147	3.8
6	37	1.4	92	2.0
7	26	2.1	56	1.0
8	8	....	30	0.5
9	1	....	20	0.3
10	9	0.5	13	0.2
11	5	0.3	10	0.1
12	3	0.2	8	0.1
13	1	0.1	4	0.04
14	....	....	1	0.01
Sum	1,800	100.0	1,800	99.9
Average size		2.3		2.3

nities still vary in their dates of founding. The method of this paper assumes that $\varphi(n)$ and m remain constant with time, but this is far from true for large $\varphi(n)$ if the birth rate is undergoing rapid changes. Of the estimated mean fraternal size in a population with a changing birth rate it may be said that while it is not the mean size at the time of birth of the propositus children, it lies between this size and the mean size at the mean time at which the families of these children were being started.

In a population having over four-fifths of completed fraternities of size five or less (Table I) the hazards of estimate would not appear to be very serious. In the test case of fraternities of college students, the estimated average size and the actual average size agree in the first decimal place, and the discrepancies in the estimated and actual distributions of fraternal sizes are not such as to suggest an influence of decreasing fecundity.

SYMBOLS EMPLOYED

$\varphi(n)$	proportional to number of fraternities which will be completed with n children.
N	number of children in sample.
$N(\nu)$	number of children in sample of birth order ν.
$\delta N(n)$	$N(n)-N(n-1)$.
m	estimated average size of completed fraternities.
$\varphi'(n)$	number of fraternities of size n in a sample of completed fraternities.
$p(n)$	$N(n)/N$, the proportion of n-th born children in sample.
σ	standard error of m.
S_n	standard error of $\varphi(n)$.

KARL PEARSON AND MATHEMATICAL STATISTICS

By Burton H. Camp, *Wesleyan University*

The retirement of Karl Pearson as professor at the University of London and director of the Galton Laboratory marks the culmination of a most notable chapter in the development of statistics. From many parts of the world men and women have come to his laboratory to listen to his lectures and to conduct their own researches in his stimulating presence. His editorship of *Biometrika* has made for that journal its position of prime importance as a repository for contributions to theoretical statistics.

Before reviewing Pearson's mathematical work it is necessary to pay respect to his personal qualities as a teacher and a scholar. It would be impossible for one who has been in close touch with him not to feel compelled to do this, and in addition these qualities have an important bearing on a proper interpretation of his writings. First of all he is friendly. This is probably not appreciated to the degree to which it is true by those who have been only his readers, for there is much in what he has written that is caustic. His critics have been dealt with in severe and able language. Sometimes it has been obvious that this has been well deserved, when they saw only a little of what he meant and gave publicity to palpably incorrect interpretations or to naïve criticisms of his views. But sometimes it has not been deserved, or at all events not obviously deserved, and then of course it reflected adversely on its author, but it does not follow, as some may have supposed, that he is given to shallow judgment or that he is unkind. Rather, if I may apply an Americanism to so staunch a Briton, he is quick on the trigger. I once had a cowboy friend at Harvard who used to say that Cambridge was all right, but as for him, he preferred a country where there was "jest a little smell of gunpowder in the air, not enough to make it disagreeable, but jest enough to make everybody polite, one to the other." He would have loved the Galton Laboratory when Professor Pearson was about, and—this is the point of the story—the rest of us loved it too; for with the brilliant mind and its masterful repartee lives as warm and kind a heart as a teacher ever had. It cannot be said of him as of some that he is so engrossed in things scholarly as to leave out the human touch. Indeed, strange as it may seem, something which is almost the reverse of that is true: although one cannot be in his presence without recognizing that here is a distinguished person, one wants to be in his presence not because he is distinguished

but because he is lovable. Every year at the laboratory a reunion is held of such of his former associates and pupils as are near enough to come. What impresses the stranger most about these meetings is that these persons seem to have come to do honor not so much to the philosopher as to the friend.

At his laboratory there was truly an association of scholars. Although local students were there working for degrees, for the most part those who had come were working simply for the development of science. Professor Pearson was not only the acting head of his laboratory, but was vital in every one of its activities. Anthropologists, biologists, sociologists, psychologists, mathematicians and others were there together, each working on his own problem, and once, frequently twice, every day, Professor Pearson sat down with each individual and thought through his work with him. He was indeed so very helpful it was even embarrassing, for it is not always easy to show progress in research twice a day. Pearson is indefatigable. He arrived at the laboratory early in the morning before others were admitted and left long after others were excluded. He hurried through lunch and beat his staff back to the books. He did not attend the British Empire Exposition in 1924. It was only a ten minutes' ride from his office, but he said he did not have the time. He was even then, at age 67, working at home late at night. He was taking a month's so-called vacation in August, but carrying his work with him, and coming back to London once or twice a week.

He is painstaking in two important respects. First, his mathematics is essentially rigorous. I was somewhat surprised to find that this was so, for coming from a background of training in analysis and having read most of his papers, I had the feeling that his mathematics might be a bit on the hop, skip and jump order, but I found that although his writings did not always mention the fine points, still they were in his mind, and really had been taken care of. Secondly, his computation, though naturally accurate, was always thoroughly checked, and he has insisted on similar care among his associates. Much of Pearson's theoretical work will, of course, ultimately be rewritten, perhaps several times, but the voluminous tables which he and his staff have compiled will for the most part never be recomputed. It is a comfort to know that they are trustworthy. The problem of computing a truly reliable table is not the simple one which those who have not done it commonly suppose, and a prodigious amount of work, both of routine and of theoretical nature, has been done at the Galton Laboratory on tables. The following tables at least should be mentioned: *Tracts for Computers, Tables for Statisticians and Biometricians* (2 volumes),

Table of Twenty Place Logarithms, Tables of the Incomplete Gamma Function. In connection with the construction of the latter much theoretical work was done on the problem of interpolation (see also the following by Seimatsu Narumi, one of Pearson's pupils: "Some Formulae in the Theory of Interpolation of Many Independent Variables," *Tôhoku Mathematical Journal*, vol. xviii, pp. 309–321).

This account of Pearson's scientific activities will have to be restricted almost exclusively to the mathematical part, but, although probably his eminence is due primarily to his success as a mathematician, his contributions to other sciences have been very important indeed. It is difficult to do justice even to his mathematics without incursions into various other fields, as will be evident from some of the titles to be cited below. This is especially true of his papers in the *Draper's Company Memoirs.* The record of his work is scattered through many volumes. His writings in *Biometrika* alone total about 1,500 pages, not including papers under joint authorship and others obviously done under his immediate supervision. He has written no book on mathematical statistics. Many wish that he would do so, for his writings have a clearness of exposition hard to match and he has at his command a great wealth of illustrative material. Possibly now, after his retirement from the laboratory, this hope of his friends may be considered more favorably.

One of his most important early papers on statistics was "Skew Variation in Homogeneous Material," *Philosophical Transactions of the Royal Society*, A, vol. 186 (1895), pp. 343–415. This contains a complete exposition of his now well known frequency curves (the fundamental types). Other frequency curves have been suggested, such as the so-called Gram-Charlier series of Hermite's polynomials, which had been tabulated by Pearson in the guise of tetrachoric functions, and various generalizations of both types. For a time there was much discussion as to which sort of frequency curves was the most valuable. This was rather regrettable. Both the Pearson and Charlier types spring from natural assumptions and both are valuable aids in analysis. Although it is a striking fact that almost every natural frequency distribution can be fitted by one of Pearson's curves or by a few terms of Charlier's series, it does not follow that either of these systems comprises in some hidden sense a natural law, and prolonged argument as to which gives the better fit would not appear to be justified on that ground. Certain of Pearson's curves are, of course, coming into prominence now in another connection, namely as the theoretical forms which are satisfied by the sampling distribution of certain statistical parameters.

Pearson's discovery of the chi-square test of significance was published in the *Philosophical Magazine* in 1900 with tables, vol. 50, pp. 157–175. The theory as then announced was essentially sound and has been of great value. As pointed out by Fisher and others, that theory would better be modified if used otherwise than in the ideal case, that is, the case where the universe sampled is supposed known. This modification turns out to be quite simple fortunately, and, as clearly stated by Irwin in the *Journal of the Royal Statistical Society*, vol. 92 (1929), p. 264, it is not absolutely necessary. It is a matter of precisely what question in probability one wishes to solve. It should also be pointed out that, by using too fine a division, Pearson at first carried some of the implications of his theory to an unwarranted extreme.

The theory of sampling runs through many volumes of *Biometrika*. When this theory was developed the samples were supposed fairly large and for the most part the discussion had to do with the discovery of formulae for the standard deviations of various statistics, a very important matter which is basic to the whole theory of sampling. Pearson was not at that time interested in the modern question of small samples and again he sought usually a solution for the ideal case when the universe sampled was supposed known. Again it is true that the modern improvements are often made possible by shifting the questions in probability from the questions whose solution was sought by Pearson to similar but not exactly identical ones whose solution for small samples it is easier to obtain. These early papers of his on sampling are marked by a thoroughness and completeness that have not been fully appreciated. Together they form an admirable text on the foundations of the subject. Latterly he has contributed to the small sample theory. This he thinks of as valuable but not so valuable as it sometimes appears. It should not, he thinks, be swallowed whole:

> Experimental work of a very useful kind has been started to discover how far the present mathematical theory of small samples can be extended to other than a single type of parent-population; but it is too early yet to be dogmatic as to the limits within which the application of such theory is valid. In particular I hold that the so-called "z" test as usually applied to small samples, especially when it is used to measure the probability or improbability of identity in the constants of small correlated samples, really requires further consideration. (1931.)

The idea involved in the coefficient of correlation was initially due to Galton, and it was originally called Galton's function, but Pearson's work on the development of this theory has been so important that the coefficient is now commonly known as his. The following papers should be mentioned here: "Regression, Heredity, and Panmixia," *Philosophical Transactions of the Royal Society*, A, vol. 187 (1896), pp.

253–318; "On the Influence of Natural Selection on the Variability and Correlation of Organs," same journal, A, vol. 200 (1903), pp. 1–66; "Novel Properties of Partial and Multiple Correlations," *Biometrika*, vol. 11 (1915–17), pp. 231–238. Pearson has investigated also other measures of interrelation such as the coefficient of contingency; *e.g.*, "On the Theory of Contingency and Its Relation to Average and Normal Correlation," *Draper's Company Research Memoirs*, Biometric Series, vol. 1 (1904). These other coefficients are not so valuable as the coefficient of correlation, however, and the same is true of various coefficients advocated by others, and Pearson has been forced to spend a good deal of labor in proving this. His tetrachoric "r" is theoretically the best measure of interrelation in a fourfold table, being in fact the very "r" of that normal surface which precisely fits the table. For many years it suffered in popularity because of the difficulty in its computation. That difficulty is now completely removed with the publication in 1931 of his second set of Tables (*cf.* also *Biometrika*, vols. 11, 19, and 22). The problem of polychoric "r" is still in a less satisfactory state (*cf.* an article by K. and E. S. Pearson, *Biometrika*, vol. 14, pp. 127–157), and it is especially because of this fact that the coefficient of contingency is used, but the latter is an unsatisfactory substitute, partly because it does not depend on the order in which the columns (or rows) of the correlation table are arranged. In this connection it is pertinent to note that at an early date Pearson recognized the error in dealing with a merely ordered series as if it were measured, by the method of assigning to it arbitrary numbers, and emphasized as the only scientific basis of measurement the method of graduation by means of a normal curve. This method lies at the foundation of much of the technique of the psychologist and the educationalist and the use of the Kelly-Wood table and others.

Pearson has been much interested in the history of statistics and is an avid reader of the early masters of the theory of probability, Bernoulli, Laplace, and others. It was by a brilliant inference that he found a rare appendix to a volume of De Moivre which showed that De Moivre and not Gauss or Laplace was the real author of the normal law, in the sense that De Moivre first gave the relation between this exponential function and the point binomial of probability theory.

The above paragraphs have to do with Pearson's thoughts on some matters that are familiar to all of us. For the rest it is perhaps sufficient to pick out from a large number half a dozen subjects with brief references for each, merely to indicate the variety of his interest in mathematical statistics: Probability that two samples belong to the same population, *Biometrika*, vols. 8, 10, 24, 25; hypergeometric series,

simple and double, *Biometrika*, vol. 16 (*cf.* also Romonovsky, vol. 17); bivariate surfaces, *Biometrika*, vol. 17 (*cf.* also Rhodes, vol. 14, Narumi, vol. 15); properties of Student's z, *Biometrika*, vol. 23; ranked individuals, and ranked variations, vols. 23 and 24. His earlier work in the fields of engineering and of mathematical astronomy is also important, but would not particularly interest readers of this JOURNAL.

Pearson has given much of his energy to the study of eugenics and anthropology, and although these are not our primary interest, they are too interesting to omit altogether. To quote from the University College Magazine:

> In the field of Eugenics, he has ever stressed the importance of the careful collection of information before any valid theories can be formed. *The Treasury of Human Inheritance* which has been published in a number of parts, represents the first and still the only attempt in England to provide material on an adequate scale for the study of human genetics. His contributions to the scientific study of physical anthropology have been perhaps as great as those of any other man. A recognition of their value was shown in 1932 when the Rudolf Virchow Medal was presented to him, the only anthropologist not a German to have received this honor. His contributions to medical knowledge were also recognized when he was made an Honorary Fellow of the Royal Society of Medicine, a very unusual honor for a layman, while he is the only man outside the insurance world to be a member of the Actuaries Club. The year 1930 saw the completion of the third and last volume of a great labor of love, *The Life and Letters of Francis Galton*. Those who glance at even a portion of it will begin to understand, not only what Galton was, but what Karl Pearson has been and is.

Pearson's scientific achievement is thus another excellent illustration of the old truth that progress in both mathematics and practical science is specially fostered when they are permitted to interact the one on the other. The modern mathematical theory of statistics apparently owes its existence to the need for solving practical problems in the theory of inheritance, and much of modern biometry would not exist if this study had not elicited the interest of a mathematician. At this moment a committee of the American Statistical Association is at work on the problem of how best to nurture in this country the development of mathematical statistics and how to supply mathematical tools to the so-called practical statistician. It would appear that the story of Pearson might give the best possible solution, namely the founding for scholars in this country of a laboratory similar to his, with a mathematician of his promise who will study all their problems with them. If the latter objective appears too difficult to realize, it affords for that very reason a striking commentary on what he has accomplished.

Professor Pearson retires after forty-two years of service at University College and twenty-four years as the head of the Galton Labora-

tory, this position having been transferred to him by Sir Francis Galton two years before his death in 1911. Pearson's position is now being shared by his son, Egon Pearson, who is head of the department of statistics at University College, and by R. A. Fisher, who is Galton Professor of Eugenics and in charge of the Galton Laboratory.

CRITERIA OF DIFFERENTIAL MORTALITY

By Harold F. Dorn and Samuel A. Stouffer

In general, students of social phenomena have two possible ways of reporting the results of their investigations. They may report their findings as unique historical facts which they have observed without attempting to draw any generalizations from them. Thus, the vital statistician studying differential urban and rural mortality might report a rural death rate of 9 per 1,000 and an urban death rate of 10 per 1,000; whether or not this difference was significant would not concern him, since he is merely reporting an observed historical fact. More often, however, the other alternative is followed and the results are reported, not as unique historical events, but as the basis of generalizations which may be applied to other than the data under immediate observation. It is quite obvious that the latter procedure involves a much more careful and critical analysis of the data than the former; for, while the fact that the urban mortality rate was found to be 1 per 1,000 greater than the rural at some particular time may be very interesting historically, it is of little value in formulating a public health program until it is known whether or not this represents significantly different mortality conditions and is likely to be repeated again.

It should be observed that in actual practice these two ways of procedure are frequently confused. The results of a study are often reported as historical facts but with a sort of implied inference that the observable differences or similarities are significant. In many cases the original data are not published but only the calculated averages, percentages, or other constants, so that the reader is forced to conclude that the study must be rejected with the verdict "not proven" or to accept it at its face value. Since the latter is the course usually adopted, especially if one is writing a textbook, it follows that conclusions are often based on differences which are statistically insignificant in the sense that chance alone could have produced them.

By chance is meant, of course, not something occult and mysterious, but merely the operation of a large number of small independent causes whose effects tend in the long run to cancel each other. The minor causes subsumed under the name of chance are presumably of the same sort as a major factor such as malnutrition or insanitation, but they are individually of so small importance and cancel each other's effects to such extent that it is either impossible or not worth while to attempt

to enumerate them. Sometimes, however, they give the superficial impression that a major factor is more important than it really is.

The usual method of determining differential mortality is to compute the respective death rates and estimate by inspection whether or not they differ significantly. None but the tyro in statistics considers comparing crude death rates of communities with unlike age, sex, nativity, or racial composition. But if the specific death rates by age and sex are computed for the separate nativity or racial groups, not only is it difficult to summarize the results in brief, concise terms, but the errors in the rates are frequently so large as to be misleading. It is customary to report the death rates from specific diseases per 100,000 so that large differences in the rates may not be significant if the base population is less than that number. If the base population is 10,000 and the rate is reported per 100,000, a difference of one death will cause a difference of 10 in the death rate. Such a situation is not so infrequent as one might suppose if age specific rates are being computed. Even if the total population under consideration is well over one million in number, the population in certain of the age groups will be considerably less than 100,000 and, in the older age groups, may be as small as 10,000. The 1930 census of population reported 1,802,976 urban native white males in Ohio but the number at age 75 and over was only 19,201, so that the difference between two death rates of 125 and 130 per 100,000 if computed for the urban native white males in Ohio at age 75 and over and for native white males in some other population of about the same size could be due to a difference of only one death. Yet one would be tempted to consider such a difference significant if reported in an array of age specific death rates.

Conciseness of summary is often achieved by the computation of standardized or adjusted rates. These do not, as has sometimes been supposed, represent the true mortality conditions in any population but are average death rates weighted so as to give equal importance to differences in age, sex, or some other factor in the populations under investigation. Obviously these rates will vary with the weights taken as a standard and should be interpreted as index numbers rather than as mortality rates, since they represent what the mortality rates would be in two populations with unlike age or sex composition if these factors were the same in both, other conditions remaining constant.

There are two drawbacks in using standardized death rates as criteria of differential mortality. Since they are weighted averages they are subject to the disadvantages of any average, particularly in that they tend to obscure variability. The aged might be dying in excess in one population and the young in excess in another population

but the two standardized death rates could still be the same since these influences would tend to cancel each other in an average rate. Our conclusion that, on the average, mortality conditions were the same in the two populations would be true but misleading. Unless mortality conditions tend to be uniformly worse at all ages in one population than in another, standardized rates may frequently obscure interesting differences.

Even if standardized rates are computed, the problem still remains of determining whether or not the difference between these rates is significant. Suppose that standardized rates of 8 per 1,000 for the rural population and 10 per 1,000 for the urban population are reported, are mortality conditions worse in urban than in rural communities? If these rates were based on populations of 1,000,000 each, there would be little hesitation in saying that mortality conditions were significantly worse in urban communities; if the base populations were 10,000 each, there probably would be some doubt as to whether or not the difference was important; and if the base populations were but 1,000 each, considerably less confidence would be placed in the rates. If some persistent questioner demanded a reason for this discrimination, the answer would be that the numbers were so small in the latter case that wide fluctuations might easily occur. But why should wide fluctuations be expected? Partly from a worship of large numbers, partly from experience, and partly from a "general feel for the data." If the questioner were inclined to be skeptical he probably would require more objective criteria, for different people might have different experiences and consequently a different "feel for the data."

We shall consider two such criteria: First, the well known chi-square test; and, second, a more sensitive test, based on sums and differences of differences, which we have not seen presented elsewhere, though it may have escaped the writers' notice.

The first method is the chi-square test for goodness of fit, originally developed by Karl Pearson and later modified and extended by R. A. Fisher and others.[1] The number of observations in any cell of a manifold classification is compared with the number expected by some hypothesis and the probability of the occurrence of a discrepancy

[1] For a discussion of the test see: G. U. Yule, *An Introduction to the Theory of Statistics*, 9th ed., 1929, pp. 370–389; R. A. Fisher, *Statistical Methods for Research Workers*, 4th ed., 1932, Chap. IV; L. H. C. Tippett, *The Methods of Statistics*, 1931, Chap. IV. An excellent proof and discussion of the test is given by T. C. Fry, *Probability and Its Engineering Uses*, 1928, Chap. IX.

In this connection where chi-square is used to test for independence alone, see especially: R. A. Fisher, "On the Interpretation of χ^2 from Contingency Tables and the Calculation of P," *Journal of the Royal Statistical Society*, pp. 85, 87–94, 1922; G. U. Yule, "On the Application of the χ^2 Method to Association and Contingency Tables with Experimental Illustrations," *Journal of the Royal Statistical Society*, pp. 85, 95–104, 1922.

as large or larger than the one observed is computed. If x_i is the number expected and f_i is the number observed in the i-th cell, then

$$\chi^2 = \sum_{i=1}^{m} \left[\frac{(f_i - x_i)^2}{x_i} \right]$$

where m is the number of cells.

An important application of the method is in testing for independence in association or contingency tables. An example of this class of tables is the classification of a population as urban or rural and a reclassification of each of these groups as dead or living. This particular illustration yields a four-fold table; the classification, of course, may be many fold. In testing for independence we assume that the frequencies in the body of the table will be distributed at random with the restriction that they must add up to the marginal totals. The expected values are calculated from the marginal totals observed; in the case of a four-fold table only one such value need be computed since the others may be written down immediately by subtraction from the margins. If f_1 and f_2 are the two observed frequencies and s_1 and s_2 are the corresponding totals.[1]

$$\chi^2 = \frac{(P_1 - P_0)^2}{P_0 Q_0 \left(\frac{1}{s_1} + \frac{1}{s_2} \right)} \quad \text{where} \quad \begin{aligned} P_0 &= (f_1 + f_2)/(s_1 + s_2) \\ Q_0 &= (1 - P_0) \\ P_1 &= (f_1/s_1) \end{aligned}$$

The value of P is determined by entering the table of chi-square with n, the number of degrees of freedom, equal to the number of cells that may arbitrarily be filled in. In the case of a four-fold table n is taken equal to one when we are testing for independence.[2]

Since we do not know the true differential between urban and rural mortality, we may test the hypothesis that there is no real difference and estimate the probability of drawing two samples with the observed discrepancy from such a population. Small values of chi-square indicate that our hypothesis is approximately correct, while large values

[1] Fisher, *op. cit.*, pp. 89, 90.

[2] P represents the probability that any given value of chi-square shall exceed any specified value. As chi-square varies from zero to infinity, P varies from one to zero. The relation between them is complex and may be found in tables. Yule, *op. cit.*, p. 388, gives a table when n equals one. Fisher, *op. cit.*, gives a more extended table. In using Elderton's Table in *Tables for Statisticians and Biometricians*, Part I, pp. 26–28, it should be noted that, in this connection, the table should be entered with n' equal to n increased by unity. This table was computed for the case where the theoretical distribution is made to agree with the observed data only in respect to its total, and n' was taken equal to the number of cells. Fisher has since shown that when we are testing for independence and placing the restriction that the marginal total must also agree that the table may still be used by setting n' equal to n increased by unity.

A convenient rule for determining the number of degrees of freedom when r is the number of rows and c is the number of columns is $n = (r-1)(c-1)$.

indicate the contrary. Since the chi-square test measures either agreement or lack of agreement with some hypothesis and not the degree of this relation, only certain values of P are pertinent to our investigation. It seems reasonable to consider any value of P greater than .05 as not disproving our hypothesis, values between .05 and .01 as indicating possible disagreement, and values less than .01 as showing that our hypothesis is probably false.

The test indicates discrepancies of any kind, whether due to errors in the collection of the data, clerical errors in copying, or to factors pertinent to the study; consequently, the evaluation of the results depends upon the investigator. It might be shown that urban mortality conditions were significantly worse than rural mortality conditions in the sense that the chances were very small of drawing two samples with the observed discrepancy from a population in which there was no difference between urban and rural mortality conditions as shown by the number of deaths, but before we could place much confidence in the result, we should have to satisfy ourselves that our data were reasonable estimates of the actual situation. This, however, is true of any investigation; for not only are the data we collect at best only indicia of the material which we wish to investigate and involve the consideration of whether or not they are valid indicia, but also it must be shown that the data are reasonably accurate.

TABLE I

DEATH RATES PER 1,000 NATIVE WHITE POPULATION BY AGE AND SEX WITH CORRESPONDING VALUES OF CHI-SQUARE, URBAN AND RURAL, OHIO, 1930 †

Age	Male			Female			
	Urban	Rural	χ^2_m	Urban	Rural	χ^2_f	$\chi^2_m+\chi^2_f$
0– 4	17.1	16.5	1.40	14.0	13.8	.08	1.48
5– 9	2.2	1.9	3.71	1.4	1.5	.20	3.91
10–14	1.5	1.4	.20	1.1	1.3	2.52	2.72
15–19	2.5	2.2	1.84	1.9	2.1	.75	2.59
20–24	2.8	3.6	10.78**	2.7	3.4	7.24*	18.02*
25–29	3.2	3.7	2.39	3.3	3.6	.80	3.19
30–34	4.1	3.4	6.17**	3.6	3.8	.34	6.51**
35–44	5.9	4.9	15.40*	4.8	4.7	.55	15.95*
45–54	11.4	7.6	99.67*	9.6	8.0	17.82*	117.49*
55–64	24.7	16.8	148.17*	19.2	16.6	18.58*	166.75*
65–74	57.3	43.8	108.77*	44.7	40.3	13.56*	122.33*
75 and over	138.8	117.8	42.77*	119.0	121.7	.85	43.62*
Total	9.9	11.0	441.27*	8.8	10.5	63.29*	504.56*
Adjusted rate	10.4	8.7		8.6	8.3		

† See this JOURNAL, Vol. XXVII, No. 180, pp. 401–12, for the original data on which these rates are based.

* Indicates a value of P less than .01.

** Indicates a value of P between .01 and .05.

For other values of χ^2, P is greater than .05.

The computation may be made using proportions or the absolute frequencies. In the latter case the formula becomes

$$\chi^2=\frac{(f_1-s_1P_0)^2}{P_0Q_0}\left(\frac{1}{s_1}+\frac{1}{s_2}\right).$$

Using the data for males 0–4 years of age

	Dead	Living	Total
Urban	3,006		175,474
Rural	1,671		101,102
	4,677		276,576

Note that it is not necessary to fill in the column headed "Living."

$$\chi^2=\frac{(3006-2967.3286)^2}{(.016910)(.983090)}\left(\frac{1}{175,474}+\frac{1}{101,102}\right)=1.40$$

$$P_0=\frac{4677}{276576}=.016910.$$

Considering the death rates per 1,000 native white population for males, rural and urban, we notice (Table I) that the urban rates are higher than the rural rates for all ages except 20–29 years. While the urban crude rate is less than the rural crude rate, the opposite is true when allowance is made for differences in age composition as shown by rates (adjusted on the basis of the standard million population of England and Wales of 1901) of 10.4 and 8.7 respectively. The application of the chi-square test shows that the difference is insignificant until the age group 35–44 years, with the exception of ages 20–24 and possibly 30–34, although in the latter group the evidence is not conclusive according to the criteria of significance previously mentioned.

Referring to the rates for females, the rural rates are higher than the urban rates for ages 5–34, while the urban rates are higher at the other ages. This case illustrates the point discussed above in connection with standardized rates. Since mortality conditions for females are not uniformly worse at all ages in urban communities as compared with rural communities, the corresponding standardized rates show very little difference, being 8.6 and 8.3 respectively. Applying the chi-square test significant differences are noted at ages 20–24 and 45–74.

Having determined at what ages there is a significant difference between urban and rural mortality conditions we now seek a method of combining this information into a summary figure so that we may

answer the question: Is there a significant difference between urban and rural mortality rates after making allowance for age composition? This may be done by adding the values of chi-square for the separate age groups.[1] This procedure is valuable in that it will show up discrepancies which are too slight to be revealed at any given age group. The number of degrees of freedom is equal to the sum of the degrees of freedom corresponding to the values of chi-square used.

For the males the total chi-square secured in this manner is 441.27 and entering the table of chi-square with n equal to 12, P is less than .01. This we interpret as indicating that there is a significant difference between urban and rural mortality conditions as shown by the number of deaths after making allowance for differences in age composition. Corresponding values for the females are 63.29, n equal to 12 and P is again less than .01. The same interpretation also holds.

The values of chi-square may be added for each age group and for all ages. The former addition enables us to determine the ages at which urban and rural mortality are significantly different after making allowance for sex variability, while the latter is a summary of all the data in the table and yields a value of chi-square taking into consideration both age and sex. This value is 504.56, n equals 24, and P is less than .01. The interpretation is that urban or rural residence is a differentiating factor in mortality even after making allowance for differences in age and sex composition. This application of the test is somewhat different than that proposed by Karl Pearson.[2]

In like manner we could test the urban and rural foreign-born white and colored mortality rates. From such computations a total chi-square could be obtained indicating whether or not, after taking into consideration differences in age, sex, nativity and racial composition there exists a significant difference between urban and rural mortality conditions. But this is not the question which we are most interested in answering. We want to know not only whether or not urban mortality conditions are *different* from rural mortality conditions, but also whether or not urban mortality conditions are *worse* than rural mortality conditions. Since chi-square is a squared quantity, any difference may be either in excess or in deficit, the value of chi-square being the same in both cases. Of course, for any single age group inspection of the rates will indicate which of the two is the greater, but there is another method available which not only indicates the nature of the

[1] Fisher, *op. cit.*, p. 83.

[2] Karl Pearson, "On the Theory of Multiple Contingency with Special Reference to Partial Contingency," *Biometrika* 11, 145–158.

——— and J. F. Tocher, "On Criteria for the Existence of Differential Death Rates," *ibid.*, pp. 159–184.

difference but also enables us to answer some further questions which we may wish to ask.

It should be apparent that in the case of a four-fold table the chi-square test is an extension of the ordinary method of finding the significance of the difference between two binomial means, with the important property that the information for several such tests may be combined. That this is true may be seen from Table II, columns 1 and 2. These values were computed by the usual method of finding the significance of the difference between two proportions.[1]

It will be noted that the values in columns 1 and 2 of Table II are the square roots of the corresponding values of χ^2_m and χ^2_f in Table I. The proper sign may be attached to the values in Table II. It is now readily apparent that at ages 20–24 the rural mortality rate is significantly greater than the urban mortality rate for both males and females but that the urban mortality rate is significantly greater than the rural mortality rate from age 35 and over for the males and from ages 35–74 for the females. We take the same criteria of significance as before.

Suppose that we wished to answer the following questions: At what ages is the urban mortality rate greater than the rural mortality rate after making allowance for differences in sex composition, and, is the difference between urban and rural mortality rates greater for males than for females? We may proceed as follows:

Let ${}_uR_m$ equal the urban male mortality rate, based on s_1 cases,
${}_uR_f$ equal the urban female mortality rate, based on s_1' cases,
${}_rR_m$ equal the rural male mortality rate, based on s_2 cases,
${}_rR_f$ equal the rural female mortality rate, based on s_2' cases,
then $({}_uR_m - {}_rR_m)$ has a variance of $p_0q_0(1/s_1+1/s_2)$
and $({}_uR_f - {}_rR_f)$ has a variance of $p_0'q_0'(1/s_1'+1/s_2')$.

$({}_uR_m - {}_rR_m) - ({}_uR_f - {}_rR_f)$ has a variance of the sum of their separate variances. We are testing the hypothesis that $({}_uR_m - {}_rR_m) - ({}_uR_f - {}_rR_f)$ is zero. If this hypothesis is true then $p_0q_0 = p_0'q_0' = P_0Q_0$. In most cases we do not know the value of P_0Q_0. In the absence of any

[1] $\dfrac{P_1 - P_2}{\left[P_0Q_0\left(\frac{1}{s_1}+\frac{1}{s_2}\right)\right]^{1/2}}$. An alternative formula is $\dfrac{P_1 - P_2}{\left[\frac{P_1Q_1}{s_1}+\frac{P_2Q_2}{s_2}\right]^{1/2}}$.

The difference between these two formulas is usually slight, but a somewhat more stable estimate of the unknown standard deviation is probably given by the former.

The computation for the males aged 0–4 years is (referring to the footnote to Table I):

$$P_1 = \frac{3006}{175{,}474} = .017131;\ P_2 = \frac{1671}{101{,}102} = .016528;\ \frac{.017131 - .016528}{\left[(.016910)\,(.983090)\left(\frac{1}{175{,}474}+\frac{1}{101{,}102}\right)\right]^{1/2}} = 1.19.$$

better estimate it would seem reasonable to take $P_0=(s_1+s_2)p_0+(s_1'+s_2')p_0'/(s_1+s_2+s_1'+s_2')$ and $Q_0=1-P_0$. Hence take

$$\frac{({}_uR_m-{}_rR_m)-({}_uR_f-{}_rR_f)}{[P_0Q_0(1/s_1+1/s_2+1/s'_1+1/s'_2)]^{\frac{1}{2}}} \text{ as a normal deviate.}$$

In the same way we may test the sum of the differences since the variance will be the same in both cases.[1]

We are now prepared to answer the question: Is the urban mortality rate greater than the rural mortality rate after making allowance for sex differences? Referring to Table II, column 3, we see that making allowance for differences in sex composition the urban rate is significantly greater than the rural rate at age 35 and over, while the rural

TABLE II

VALUES OF THE RATIO OF THE DIFFERENCE BETWEEN TWO PROPORTIONS TO ITS STANDARD ERROR FOR URBAN AND RURAL MORTALITY RATES OF THE NATIVE WHITE POPULATION BY AGE AND SEX, OHIO, 1930

Age	$({}_uR_m-{}_rR_m)$ (1)	$({}_uR_f-{}_rR_f)$ (2)	$({}_uR_m-{}_rR_m)+({}_uR_f-{}_rR_f)$ (3)	$({}_uR_m-{}_rR_m)-({}_uR_f-{}_rR_f)$ (4)
0– 4	1.19	.27	1.05	.68
5– 9	1.93	− .44	1.18	1.75
10–14	.45	−1.58	− .73	1.39
15–19	1.36	− .86	.40	1.58
20–24	− 3.28*	−2.69*	− 4.22*	− .41
25–29	− 1.54	− .89	− 1.72	− .45
30–34	2.48**	− .58	1.38	2.19**
35–44	3.92*	.74	3.36*	2.35**
45–54	9.98*	4.22*	10.09*	4.20*
55–64	12.05*	4.31*	11.79*	5.88*
65–74	10.43*	3.68*	10.19*	5.20*
75 and over	6.54*	− .92	4.25*	5.49*

* Indicates a value of P less than .01.
** Indicates a value of P between .01 and .05.
For other values, P is greater than .05.
P indicates the probability of a chance difference greater than that observed regardless of the algebraic sign of the difference. The probability of a difference greater than that observed and having the same algebraic sign would be ½ P.

[1] This is only one of several slightly different ways in which the test may be made. Instead of P_0Q_0, some other estimate might be used; and, under certain conditions, it might be advisable to use weights. For example, the difference, $({}_uR_m-{}_rR_m)$, might be given a weight, $W_1=\left(\frac{1}{S_1}+\frac{1}{S_2}\right)^{-\frac{1}{2}}$, and the difference, $({}_uR_f-{}_rR_f)$ be given a weight, $W_2=\left(\frac{1}{S_1'}+\frac{1}{S_2'}\right)^{-\frac{1}{2}}$. Then the variance becomes $P_0Q_0\left\{W_1^2\left(\frac{1}{S_1}+\frac{1}{S_2}\right)+W_2^2\left(\frac{1}{S_1'}+\frac{1}{S_2'}\right)\right\}$ which reduces to $2P_0Q_0$. The ratio of the weighted sum to its standard deviation is not likely to differ markedly from the ratio of the unweighted sum to its standard deviation unless the values of S differ markedly. In the last age group of Table II, 75 and over, $S_1=19{,}061$, $S_2=24{,}838$, $S_1'=27{,}313$, $S_2'=23{,}790$. The ratio based on the unweighted sum was 4.25; the ratio based on the weighted sum was 4.03; a discrepancy of only 5 per cent, which is negligible. This was the largest difference in any age group in Table II.

The reader should keep clearly in mind the difference between the hypothesis here tested and that which was tested earlier by using the simultaneous distribution of χ_1^2 and χ_2^2. The χ_1^2 and χ_2^2 method has a wider generality, but in the particular application made in this problem does not give as full and decisive information as the procedure just discussed.

rate is significantly greater than the urban rate for the age group 20–24 years. Column 4 indicates whether or not the difference between urban and rural mortality conditions is greater for males than for females. The difference is greater for males at age 45 and over; this is very likely also true for the ages 30–44, but the evidence is not conclusive.

Our tests have indicated whether or not differences in urban and rural mortality rates could be due to age or sex as the case may be. If we had considered some other factor the results might very well have been otherwise. But after determining whether or not age and sex may explain the differences in mortality we are in a better position to investigate the influence of other factors.

The computation for the age group 0–4, Column 3 is as follows:

	Males		Females	
	Dead	Total	Dead	Total
Urban	3,006	175,474	2,375	170,113
Rural	1,671	101,102	1,338	96,733
	4,677	276,576	3,713	266,846

$$ {}_uR_m = \frac{3006}{175,474} = .017131;\ {}_rR_m = \frac{1671}{101,102} = .016528;\ {}_uR_f = \frac{2375}{170,113} = $$

$$ .013961;\ {}_rR_f = \frac{1338}{96,733} = .013832; $$

$$ P_0 = \frac{4677+3713}{276,576+266,846} = .015439;\ Q_0 = .984561 $$

$$ \frac{(.017131-.016528)+(.013961-.013832)}{\left[(.015439)(.984561)\left(\frac{1}{175,474}+\frac{1}{101,102}+\frac{1}{170,113}+\frac{1}{96,733}\right)\right]^{1/2}} = 1.05. $$

The statement that the difference between certain of the mortality rates is insignificant in the sense that it might easily occur by chance should not be interpreted as meaning that chance in the popular sense actually did bring about the difference. From actual experience we know that this is not the case; chance, as such, is not on the approved list of the International List of Causes of Death. What we mean is that we could set up an artificial population in which there was no difference between urban and rural mortality rates and by purely random methods draw two samples with the observed discrepancy. Our

interpretation is that chance *could* account for the difference, not that chance actually *did* account for it.

Objection might be raised to the use of the normal probability curve when the original distributions are as skew as the ones with which we are dealing. But it should be remembered that we are not dealing with the original distributions but with the distribution of differences and these approach normality very rapidly even though the original distributions are very asymmetrical. As an empirical test of the theory, the value of β_1, was computed for the following:

$n_1 = 8{,}274$	$n_2 = 18{,}474$
$p_1 = .001208605$	$p_2 = .001136733$
$q_1 = .998791395$	$q_2 = .998863267$

The result was .0228; for the normal curve the value is zero. Since n and p are both larger as a rule than the values used, the use of the normal probability curve seems justified so long as we do not interpret the probabilities too strictly.

There are several important limitations on the use of these techniques. The use of the chi-square test assumes that the deviations in each cell are normal. This is true only when the frequencies are not too small.

The chi-square test, of course, ignores the sign of the difference. This is remedied by employing the second test proposed although this latter does not possess the generality of the chi-square test.

Neither of the tests gives any information as to the strength of the association. They test independence only, that is whether or not departures from independence may or may not be due to chance. It will be observed that the results depend upon the size of the sample. A smaller sample would give a lower significance for the same association while a larger sample would give a higher significance.

P in itself does not establish independence or the lack of independence. The hypothesis is true only in the sense that the observations would not be miraculous if it were true. There are no definite rules for the limits of independence but the values suggested above are probably as suitable as any for most purposes.

As with all applications of statistical techniques the formal application may be correct but the justification and interpretation of the results may be very difficult. Consequently the tests should not be applied blindly but with a full appreciation of their limitations as well as their powers of analysis.

Another limitation of the methods used for testing significance is the necessity of assuming that one death is independent of another. This,

of course, is not true in all cases, especially for deaths due to contagious diseases, influenza and pneumonia.

The value of chi-square which tested the significance of the difference between urban and rural mortality rates for all male deaths at ages 0–4 was 1.40, which is not significant. If we exclude deaths from contagious diseases, influenza and pneumonia, the value of chi-square is raised to 4.24 suggesting that the net urban mortality for males of this age group may be significantly slightly greater than the net rural mortality. Values of chi-square for the age groups 5–9 and 10–14 remained substantially unchanged after subtracting deaths from contagious diseases.

At present, no method is available for appraising the extent to which the factor of contagion vitiates the use of the tests proposed. Because of the small proportion which deaths from contagious diseases bear to the total, except in a year of severe epidemic or except in the very early age periods of life, the validity of the tests used would seem not to be greatly impaired. Even in the case of the age group 0–4, where the chi-square was altered by the subtraction of deaths from contagious diseases, it is an open question as to what extent the alteration was the result of contagion vitiating the original test or to what extent it was simply a result of the fact that the incidence of contagious diseases is different in urban and rural communities.

That the latter explanation is not to be disregarded is seen when the deaths from premature births are subtracted from all deaths in the age group 0–4. These deaths surely should be regarded as independent of one another. Yet the effect of subtracting deaths from premature birth is to show the net rural death rate slightly higher than the net urban rate, reversing the original differential (although neither before nor after subtracting these deaths is the difference statistically significant).

After a little experience with mortality rates, one soon reaches the point where differences which are so large as surely to yield significant probabilities can be determined by inspection. It would be unnecessarily meticulous to insist on the necessity of testing every difference numerically. The purpose of this paper is rather to substitute a set of logical procedures for rule-of-thumb methods in cases near the border line of significance. Logical procedures become increasingly important as the size of the sample decreases due to the use of sub-classification to hold constant several factors, such as age, sex, nativity, race, and size of community.

PREDICTING RELIEF CASE LOADS FOR MINNEAPOLIS BY EMPIRICAL PROCEDURES, 1932–1933

By F. Stuart Chapin, Ernst Jacobson, and Sarah Stone, *University of Minnesota*

The rapidly mounting poor relief load and the probability of a continuing number of dependents for years to come, make the analysis of this subject one of practical importance and theoretical interest. In this paper we present the results of two years of analysis by empirical procedures that continue and advance the analyses published in 1924 [1] and 1926.[2]

Predictions of relief case loads made three to six months in advance of any calendar month are shown in columns (6) and (9) of Table I. It will be seen that our predictions for the months May through October, 1932, made in May, 1932, average 15.7 per cent below the observed. For November and December, 1932, the predictions made in August, 1932, were 9.95 per cent below and 12.35 per cent above, respectively, the observed values. By use of a more refined method of approximating the secular trend, the predictions made for December, 1932, and for January, February and March, 1933, were less than 2 per cent below the observed values. Although these latter predictions were made on January 14, 1933, they actually predict five months in advance, since the observed values of November and December were not available until after the middle of January, 1933.

Since the percentage of error is decreasing with an improvement in our technique and in any event the percentage of error is not so large but that the predictions may be useful to public administrators, we publish these results with a brief description of the method in the hope that they may be helpful to other statisticians and sociologists who are interested in the problem of predicting relief loads.

The data consist of total monthly case loads of families given relief by the Minneapolis Board of Public Welfare and the Minneapolis Family Welfare Association. Single men and women are not included. The unit is the family of two or more members. Since the average size of family in Minneapolis in 1930 was 3.2 persons the total number of individuals concerned may be approximated by multiplication.

[1] F. Stuart Chapin, "A dependency index for Minneapolis," *Publications of the American Sociological Society*, 1924.

[2] F. Stuart Chapin, "Dependency indexes for Minneapolis," *Social Forces*, V, no. 2, December, 1926, pp. 215–224.

TABLE I

TOTAL RELIEF CASES (FAMILIES) REPORTED BY MINNEAPOLIS BOARD OF PUBLIC WELFARE AND TOTAL RELIEF CASES (FAMILIES) OF FAMILY WELFARE ASSOCIATION BY MONTHS, 1929–1933

Month	1929	1930	1931	1932			1933		
				Number reported*	Predicted number	Difference from Col. 5	Number reported*	Predicted number	Difference from Col. 8
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
J.....	1,556	2,035	4,330	7,174	.....	.....	13,265	13,047 (3)	−01.64
F.....	1,726	2,242	4,545	9,483	.....	.....	14,095	13,835 (3)	−01.84
M.....	1,633	2,139	4,569	9,983	.....	.....	14,592	14,366 (3)	−01.54
A.....	1,529	2,020	4,085	9,315	.....	.....	14,172	14,009 (4)	−01.15
M.....	1,252	1,608	3,837	8,159	7,665 (1)	− 6.05	13,073	13,323 (4)	+01.91
J.....	1,216	1,562	3,710	7,673	7,015 (1)	− 8.49	12,382	13,323 (4)	+07.50
J.....	1,128	1,528	3,973	8,186	6,848 (1)	−16.34	.....	.....	.....
A.....	1,112	1,577	3,167	8,769	6,730 (1)	−23.25	.....	.....	.....
S.....	1,100	1,648	3,479	9,457	7,242 (1)	−23.42	.....	.....	.....
O.....	1,179	1,915	4,248	9,980	8,285 (1)	−16.98	.....	.....	.....
N.....	1,503	3,089	5,446	10,709	9,643 (2)	− 9.95	.....	.....	.....
D.....	1,948	3,856	7,159	12,225	13,736 (2)	+12.35	.....	.....	.....
					(3)	−00.35			

* Reported 40 days after expiration of calendar month.
(1) Predictions made in May 30, 1932, on secular trend of free-hand parabola unadjusted.
(2) Predictions extended in August, 1932, on same series.
(3) Predictions made January 14, 1933, on secular trend of $y = 100 - 3.5\,X + 0.264\,X^2$ deviations adjusted. Since on January 14, 1933, the report of the Department of Poor Relief for November was not yet available, the prediction of January 14, 1933, was for the 4-month period, D, 1932, J-F-M, 1933.
(4) Predictions made April 17, 1933, on (3) projected. Since on April 17, 1933, the report of the Department of Poor Relief for March, 1933, was not available, the prediction of April 17, 1933, was for the 4-month period M-A-M and J, 1933.

The year 1926 was taken as the base year and a relative series constructed on this base.

Our first step in the attempt to eliminate the secular trend of the relief index series was to draw in a free-hand parabola of the second order having regard for the general slope of the trend in a longer poor relief series beginning in 1915.[1] Consequently, the parabola used was drawn in consideration of longer time tendencies than those shown for the period 1926 to 1933. Next the deviations of the index series from the ordinates read off this free-hand parabolic trend were converted into sigma deviations and plotted in a curve similar to that shown for the relief index in Chart II. Since our first approximation to the secular trend was frankly taken as a rough approximation, no centering or adjustment was made, and our first predictions for May to November, 1932, were made from this secular trend. Even this rough method yielded predictions for a six-month period subsequently found to vary from the observations by an average of only −15.7 per cent. Since a free-hand curvilinear extension is not subject to verification and hence weakens the whole prediction technique, we fitted to the free-hand

[1] *Ibid.*, p. 217, Chart I, in which a linear upward trend was used. The free-hand parabola was drawn to provide a curvilinear extension of this long-term trend.

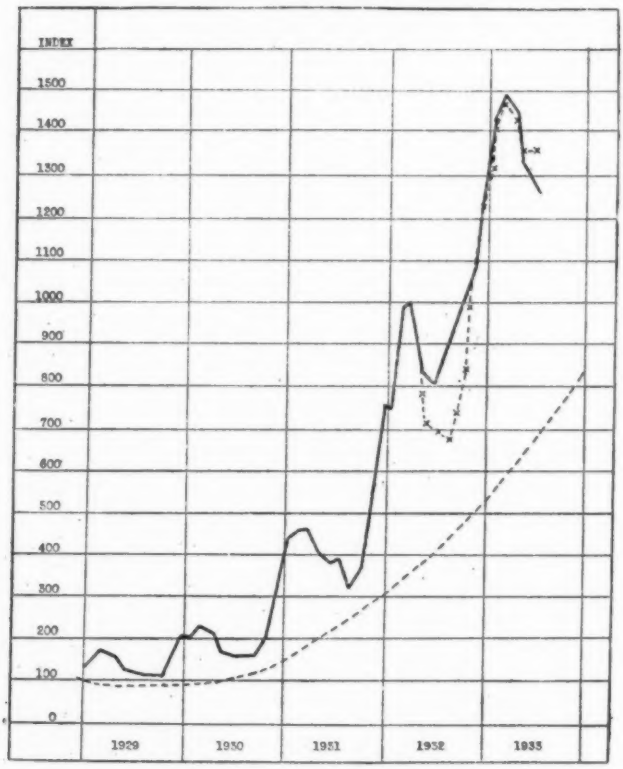
parabola, a square parabola of the form, $Y=100-3.5X+0.264X^2$, by the method of approximate three point suspension. In order to better our predictions, deviations from the square parabola were then centered. The final trend computed by this method is shown by the dotted line in Chart I.

CHART I

INDEX OF RELIEF FOR MINNEAPOLIS AND SECULAR TREND
1929–1933

1926 = 100 on Scale = 984 Cases
$Y=100-3.5X+0.264X^2$ (Origin, December, 1928)

x---x---x--- Predicted Index of Cases
——————— Index of Reported Cases



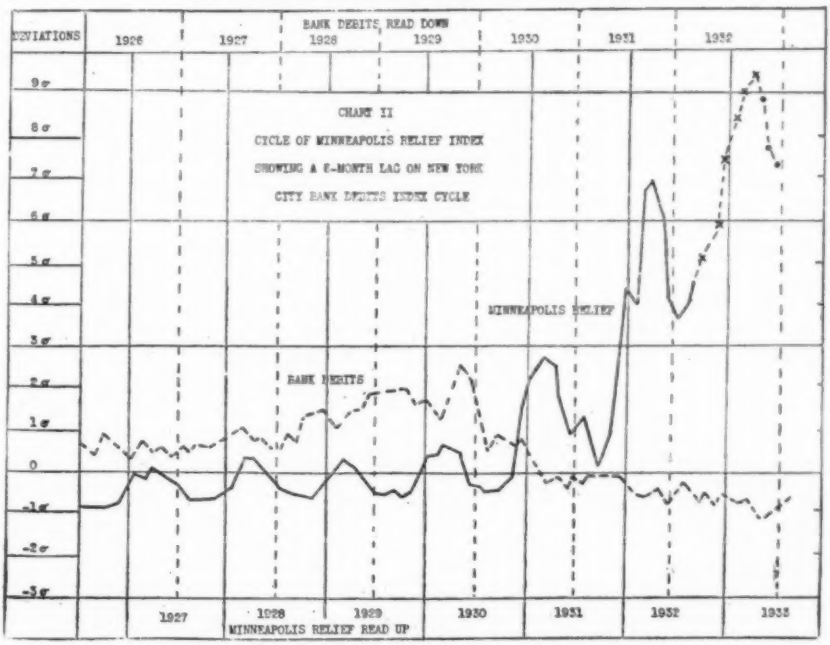
The cycle of poor relief, expressed in sigma deviations in Chart II, is derived from Chart I. It will be observed that we made no allowance for elimination of the seasonal factor. There were two reasons for this, first, a test of elimination by a mean-median method yielded a curve that behaved like a mirror image of the original index curve; and second, since seasonality is highly important and

of diagnostic value for the study of relief fluctuations, we desired to allow the seasonal factor to remain as a free variable. This procedure, a digression from the usual technique of time series analysis, appears to have pragmatic justification, since our predictions, made without mechanical allowance for seasonality, show consistently small errors.

The next problem was to discover an independent variable with sufficiently high correlation with the relief series cycle to admit of prediction. Six indices of business conditions in the Northwest [1] published by Kozelka were examined and discarded because of absence of sufficient lag to permit prediction. Next six indices of national business conditions were examined and, fortunately, the index of bank debits of New York City was found to supply the desired independent variable.[2] Correlations between the Minneapolis relief index and the New York City bank debits index gave $r = -.235$ with a 6-month lag for the period July, 1926, to December, 1931, of the relief index, and $r = -.527$ with a

CHART II

CYCLE OF MINNEAPOLIS RELIEF INDEX, PLOTTED WITH A 6-MONTH LAG OVER NEW YORK CITY BANK DEBITS INDEX CYCLE



[1] R. L. Kozelka, *Business Fluctuations in the Northwest*, University of Minnesota, 1932.

[2] *Monthly Review of Credit and Business Conditions*, Second Federal District Reserve Bank. The New York City bank debits index was converted into sigma deviations by $\frac{\text{Index}-100}{\sigma}$.

6-month lag for the period, January, 1926, to August, 1932, of the relief index. Chart II shows the relationship of the two series in cycle form with the lag indicated. Somewhat higher correlations on a 3-month lag were found as follows:

$r = -.370$ for the period January, 1926, to December, 1931, of the relief index;

$r = -.683$ for the period January, 1926, to August, 1932, of the relief index.

However, these lags were not used for two reasons: first, the 3-month lag was too short for practical prediction purposes because the observed totals of any given calendar month were not available until after the middle of the second following calendar month, thus making the 3-month lag impracticable; second, a 6-month lag provided a longer period of prediction and a stricter test of the technique.

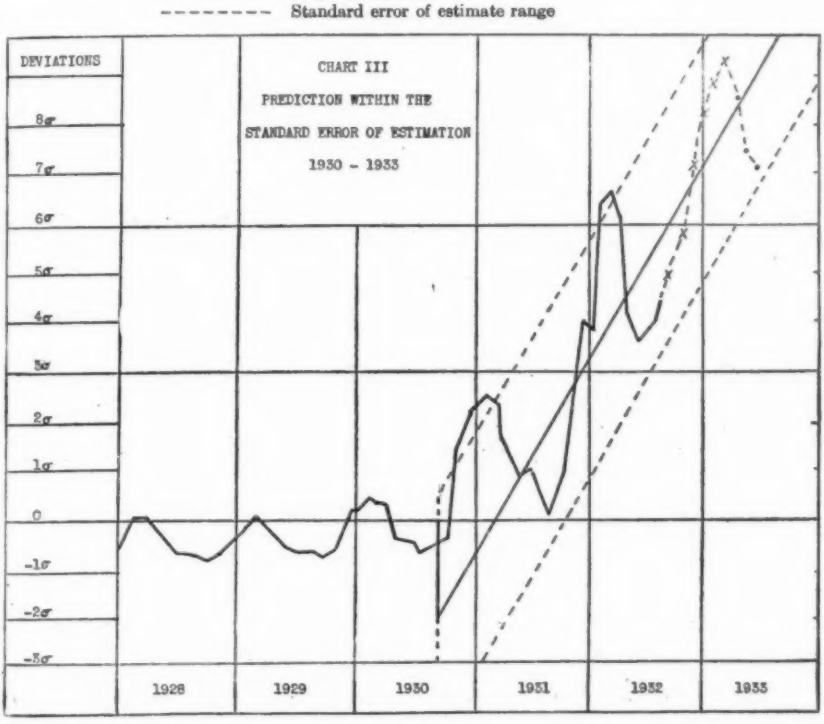
Up to this point we have described the steps of usual procedure in empirical analysis; the next point is something of a departure in procedure. It is frankly experimental and empirical and its justification at this stage of our research is wholly pragmatic, since it does work satisfactorily, although no mathematical basis is yet developed.

The problem of predicting monthly relief load is one of anticipating the main direction of the cycle underlying the monthly fluctuations and at the same time one of anticipating the seasonal fluctuations that occur with regularity as shown in Charts I and II. At this point we assume that the upward direction of the relief load cycle of Chart II will continue on the principle of a continued 6-month lag with the New York City Bank Debits Index. Having made this assumption, we then select a 24-month period ending with the last calendar month for which the Bank Debits Index is available and correlate this variable with a 24-month period of the relief index which is thus projected six months. For example, the Bank Index figures for the period March, 1930, through February, 1932, are correlated with the relief index figures for September, 1930, through August, 1932. A correlation of $r = -.626$ is obtained. From this and the sigma values of the correlation, we compute the values of the parameters of the regression equation, a and b. The value a is 2.06, and b is -4.07. It is now possible to plot this regression line as the upward direction of the relief load cycle as shown in Chart III. Next the standard error of estimate of this regression line is computed and found to be 2.66. Plotting in the range of this standard error of estimate in the form of the parallel dash lines of Chart III, we now have limits that serve as a guide in drawing the predicted seasonal fluctuations for the future six months. It is, of course, evident

that subjective factors enter in at this point. Aside from the limits of the standard error of estimate, there is only the pattern of previous seasonal fluctuations to serve as a guide. For the present only a pragmatic test is available. However, proceeding in this way we draw in the predicted monthly fluctuations for the next 5 or 6 months.

CHART III

PREDICTION WITHIN THE STANDARD ERROR OF ESTIMATION, 1930–1933



The next steps are merely routine computations, shown in Table II. Here we enter our prediction of a monthly index (expressed in sigma deviations) in the last right-hand column, or column 7. Then this value is multiplied by the value of the standard deviation; for example, taking January, 1933, we multiply 8.3 by 85 and enter the result, 705, in column 6, as the derived $(Y\text{-}O)$ value that corresponds to the sigma deviation 8.3. Then this value is adjusted by adding 61, the figure that centers the curve, thus giving 766. Next we read off from the secular trend in Chart I, the value on the curve corresponding to the month of January, 1933. This value is 560. The sum of 766 and 560

gives us the derived value of the index for the month in question and this value of 1,326 is entered in column 3. The final step is to convert this index value into the corresponding absolute number of cases, which is done by multiplying it by 984 (the mean value of the base year 1926) and dividing the result by 100. This procedure leads to the figure 13,047 as our predicted total relief cases for January, 1933.

TABLE II

COMPUTATION OF PREDICTED CASES

Month	Predicted number of cases Col. 3 × 984÷100	Index on 1926 base Col. 4+Col. 5 and 6	Value of ordinate *O*, of secular trend	(*Y-O*) values, or deviations from *O* adjusted, add 61	(*Y-O*) Values computed from Col. 7	Sigma values estimated by free-hand projection on Chart III
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1932						
M	7,665	779	405	...	374	3.5
J	7,015	713	425	...	288	2.7
J	6,848	696	440	...	256	2.4
A	6,730	684	460	...	224	2.1
S	7,242	736	480	...	256	2.4
O	8,285	842	500	...	342	3.2
N	9,643	980	520	...	460	4.3
D-1	13,736	1,396	540	...	856	8.0
D-2	12,181	1,238	540	698	637	7.5
1933						
J	13,047	1,326	560	766	705	8.3
F	13,835	1,406	580	826	765	9.0
M	14,356	1,460	600	860	799	9.4
A	14,009	1,432	632	800	739	8.7
M	13,323	1,354	656	698	637	7.5
J	13,323	1,354	681	673	612	7.2

Column 1.—D-1 is first estimate for December, 1932, based on estimate of sigma value 8.0 of Column 7; and D-2 is second estimate for December, see 7.5 in Column 7.

Column 2.—Predicted cases are obtained from entry in Column 3 multiplied by 984 (index of base year 1926) and divided by 100.

Column 3.—Index on 1926 base is derived from sums of entries in Columns 4 and 6 for March to D-1 of 1932; and the sums of entries in Columns 4 and 5 for December (D-2) of 1932 to June, 1933.

Column 4.—Value of ordinate *O*, of secular trend. For May to December (D-1) 1932 it was read off a free-hand parabolic trend; for December (D-2) 1932 to June, 1933, it was read off the parabola, $y = 100 - 3.5\,X + 0.264\,X^3$, fitted by a three point suspension method.

Column 5.—The adjusted (*Y-O*) values are obtained by adding 61 (the adjustment) to each entry in Column 6.

Column 6.—The unadjusted (*Y-O*) values or deviations of the ordinates of the series from the secular trend are computed by multiplying 107 (the standard deviation of the unadjusted series) against the estimated sigma values of Column 7 for May to D-1 of 1932; and for the period December (D-2) 1932 to June, 1933, using as the multiplier the value 85, which is the standard deviation of the adjusted series.

Column 7.—Sigma values estimated by free-hand projection within the range of the standard error of estimate of Chart III. From May to December (D-1) 1932, these values are derived by eliminating the secular trend by a free-hand and unadjusted parabola. These estimates were made in May, 1932, for May to October, and in August, 1932, for November and December. From December (D-2) 1932 to June, 1933, these values are derived by eliminating the secular trend by the parabola, $y = 100 - 3.5\,X + 0.264X^3$, fitted by a three point suspension method and the deviations adjusted. These estimates were made on January 14, 1933, for December (D-2) 1932 to March, 1933, and on April 17, 1933, for April to June, 1933. Since there is a delay of one and a half months in reporting the observed values, the estimates made in January were made without knowledge of the observed values of November or December, 1932, and hence were 5 months in advance.

The pragmatic test of our procedure lies in the degree of correspondence between the predicted totals and the totals subsequently reported. Table I, columns 7 and 10, displays the results of 14 months' predictions. Although our figures indicate some progress in the improvement of the technique, the whole procedure suffers from some fun-

damental limitations of both a practical and a theoretical nature. These will now be considered.

The greatest practical limitation is the total unpredictability of irregular fluctuations. Administrative changes in the distribution of relief such as, decision suddenly to reduce the amount of relief and thus greatly increase the capacity and resulting number of cases; change in policy in the other direction, whereby fewer cases are taken and more adequate relief given, thus diminishing the cases without reference to the natural increase; transfer of cases in large numbers to other agencies, such as the R. F. C. relief; these and other factors would effect changes in the trend and in the seasonal variations. Consequently the continued practicability of this method of prediction depends upon a continuity of policy on the part of an administration able to increase both its case work staff and the load carried in fairly quick response to the natural rise in need. Another practical limitation is the necessity of good judgment in drawing the free-hand projections of the seasonal fluctuations within the limits of the standard error of estimate and the direction of the upward climb of the cycle.

The theoretical limitations are typified by the question, what should be done when the business cycle turns? It can not go downward forever; what will you do when you hit the bottom and how will you be able to anticipate the time of the true rise of the cycle? The only answer that can be made at present is this. Assuming a continued lag and lead relationship of 6 months, there will be at least this period of leeway for experimental adjustment and trial and error. If a longer lag is found, it will simplify the problem. If a shorter lag is found, it will make procedure more difficult. Furthermore, apart from the technical lag relationship there is the fact that dependency and relief, because of their cumulative nature, tend to persist [1] long after the gross causal factors that occasioned them have ceased to operate in acute form. Perhaps all that can be said at this stage is that the authors are working at this problem which is as yet only in its theoretical stage.

To a considerable extent a satisfactory answer to this interesting theoretical problem is bound up with the problem of discovering the real meaning of the parameters in the square parabola of the trend, $Y=100-3.5\,X+0.264\,X^2$. Analogical reasoning from the meaning of the parameters in the parabola of the trajectory of a projectile, suggests that the a-term describes the normal number of relief cases of normal times. It consists of chronic paupers, and persons whose employment

[1] See Jessie A. Bloodworth, *Social Consequences of Prolonged Unemployment*, University of Minnesota Employment Stabilization Research Institute, Vol. 2, No. 5., August, 1933; also Ewan Clague and Webster Powell, *Ten Thousand Out of Work*, University of Pennsylvania Press, 1933, especially part 2 by Webster Powell.

is so irregular and whose management of their lives is so ineffectual that the slightest reverse, misfortune, or change of season, throws them upon relief. The cx^2 term represents the tendency of the number of relief cases to pile up if there were no checking factors. The $-bx$ term supplies the checking factor which sometimes keeps the family going for a period of months or years before it is finally driven to seek relief. This checking factor may include a variety of resources such as good management, use of savings, use of credit, borrowing on life insurance, and aid from friends and relatives. However adequate or inadequate these observations may be in supplying the framework for theoretical work, it is evident that they apply only to the secular trend. Theoretical treatment of the seasonal fluctuations that are superimposed upon the cycle, must give consideration to such seasonal factors as decrease of employment during the winter months and the increase of fuel orders. One represents an important economic influence culminating in the winter. The other is the reflection of weather changes on the family budget. Taken together the two factors synchronize with the seasonal increase in relief and seem an important partial explanation of the acuteness of the seasonal rise and fall of relief. The whole problem of causal relationships is complicated but unusually interesting in this field of research.

MEASURES OF THE INEQUALITY IN THE PERSONAL DISTRIBUTION OF WEALTH OR INCOME [1]

By Dwight B. Yntema

In order to measure and so to compare the commonly recognized phenomenon of inequality in personal distribution which exists at different times and in different places, coefficients of inequality [2] are employed. Such coefficients may be formulated with the object either (1) of measuring the degree of unequalness among the individual shares of the distributed attribute—wealth or income—or (2) of measuring the degree of unequalness in the distribution of a resulting character which is functionally associated with the attribute. In the case of income distribution, Hugh Dalton prefers the latter course, since primary interest concerns distribution of welfare rather than distribution of income, as such.[3] This procedure encounters the difficulty of finding the function which relates the individual's welfare to his income as well as the necessity of assuming identity between different individuals. Benham calls the resort to subjective considerations non-scientific.[4] The present discussion, however, is concerned with the first of the two alternatives, being limited to coefficients devised to measure inequality in the distribution of the attribute itself. By so doing, the problem of measuring inequality in the distribution of wealth is made formally the same as that of measuring inequality in distribution of income.

Certain *a priori* limitations may be imposed on coefficients of inequality. An acceptable coefficient must be both independent of the number of persons in a distribution, and independent of the unit in which income, or wealth, is measured.[5] And, in contrast with pro-

[1] The writer acknowledges gratefully the grant of a Sterling fellowship at Yale University, 1930–1931, which provided an opportunity to concentrate on the problem of measuring inequality. Additional attention was given this subject at the University of Michigan. The present discussion represents one phase of the work.

[2] A distinction between "inequality" and "concentration" has been made by Allyn A. Young, "Do the Statistics of the Concentration of Wealth in the United States Mean What They Are Assumed to Mean?"; this Journal, 1917, pp. 476 ff. Concentration means "undue or excessive" inequality.

[3] Hugh Dalton, *Inequality of Incomes*, 2nd impression, London, 1925, appendix, pp. 1–2. The appendix is a reprint of "The Measurement of the Inequality of Incomes," *Economic Journal*, Vol. 30, 1920.

[4] F. C. Benham, "Economic Welfare," *Economica*, 1930, p. 176. Distribution of national income, Benham considers one of several "objective indicia" of a community's prosperity (p. 177); compare his book, *The Prosperity of Australia*, London, 1930, pp. 10 ff.

[5] Cf. F. R. Macaulay, "The Personal Distribution of Income in the United States," part III in *Income in the United States*, II, National Bureau of Economic Research, New York, 1922, p. 375. The writer asserts that a proportional increase in the income of every recipient does not change inequality. Corrado Gini, "Il diverso accrescimento delle classi sociali," *Giornale degli Economisti*, 2 series, 38, 1909, p. 69; Hugh Dalton, *loc. cit.* pp. 9–11. Dalton concludes that proportional additions to all incomes decrease inequality but acquiesces to independence of the unit of measure.

cedures which require successive comparisons, either numerical or graphic, between corresponding elements of two or more distributions,[1] a true coefficient must characterize each distribution by a single definitive value which will lead to an unambiguous conclusion when the extent of inequality between different distributions is being compared. For selecting the preferable coefficients from the many that satisfy these principles, the following discretionary criteria may be proposed. The numerical value of a coefficient should not be difficult to compute. A coefficient should be more or less adaptable to the peculiarities and limitations of existing data; the footnotes of Tables I and II refer to distributions which are considered representative for the purposes of this discussion. A coefficient of inequality should admit of interpretation which is in harmony with the connotation implied in the word, inequality, however vague the connotation be.[2] Finally, coefficients having definite finite limits, 0 and 1 preferably,[3] are desirable since such limits aid in attaching significance to the numerical value of a coefficient for any particular distribution.

Below are outlined eight plausible measures [4] of the inequality in personal distribution. Each satisfies the limiting conditions stated above and is in keeping with the discretionary criteria. It may be noted that the mode, median, harmonic mean and the quartiles do not appear in the formulation of the eight coefficients; the frequency distributions employed subsequently in an empirical appraisal of the coefficients are not complete enough to permit a suitable determination of these values.

Let N represent total frequency; let Ma represent the arithmetic mean of the attribute magnitudes; and let S represent the standard attribute, i.e., the square root of the average square of the attribute magnitudes. The first six coefficients are measures of dispersion;[5] for these, the name is abbreviated in forming the symbol.

[1] For examples: A. L. Bowley, *The Measurement of Social Phenomenon*, London, 1915, pp. 210–213; L. R. Connor, "Income in the United Kingdom, 1913–1924." *Journal Royal Statistical Society*, Vol. 91, 1928, pp. 60–61, 73; W. I. King, *The National Income and Its Purchasing Power*, New York, 1930, pp. 172–179; W. I. King, *The Wealth and Income of the People of the United States*, New York, 1922, pp. 72, 79, 81, 85, etc.

[2] Cf. A. C. Pigou, *The Economics of Welfare*, London, 1924, p 84. W. M. Persons, "The Variability of the Distribution of Wealth and Income," *Quarterly Journal of Economics*, Vol. 34, 1909, pp. 431, 433, 438; Hugh Dalton, *loc. cit.*, sections 4, 7, 9.

[3] Cf. Umberto Ricci, *L'indice di variabilità e la curve dei redditi*, Rome, 1916, p. 2.

[4] Cf. L. von Bortkiewicz, "Die Disparitätsmasse der Einkommensstatistik," and the following observations and notes by C. Gini, F. Savorgnan, and G. Pietra in *Bulletin de l'Institut International de Statistique*, Tome 25, 3e livraison, 1931, pp. 189–320M. The controversy regarding "la paternité des idées" (p. 320H) has brought out pertinent references with considerable detail.

Coefficients 5 and 6, defined in terms of logarithms, have been added to the more common measures of dispersion. The list is not presumed to be exhaustive.

[5] The number of possible coefficients of dispersion is unlimited. For the deviation formulas, any of the several central positions can be used; the absolute values of the deviations from the selected central position can be raised to any desired power in the definition of a measure of dispersion. Reduction to relative terms may be accomplished through division by any of the central positions. Analogously, a

(1) $M.D\ (Ma)$ = relative mean deviation referred to Ma; the mean deviation from Ma divided by Ma.[1]

(2) $M.Df\ (Ma)$ = relative mean difference, with repetitions,[2] referred to Ma; the sum of the absolute values of differences between each attribute pair divided by $\frac{N^2}{2} \cdot Ma$.

The relative mean difference, without repetitions, is double Gini's Ratio of Concentration, R.[3]

(3) $V(Ma)$ = coefficient of variation referred to Ma; the standard deviation divided by Ma, i.e., $\frac{\sigma}{Ma}$.

The square root of the average (with repetitions) square of the differences between each attribute pair divided by Ma equals $\sqrt{2} \cdot V(Ma)$.[4]

(4) $V(S)$ = coefficient of variation referred to S; the standard deviation divided by S, i.e., $\frac{\sigma}{S}$.

Again, the square root of the average (with repetitions) square of the differences divided by S equals $\sqrt{2} \cdot V(S)$.[4]

(5) $M.D_{(\log)}$ = mean deviation using logarithms of attribute values, deviations taken from the arithmetic mean of the logarithms.[5]

---

difference coefficient can be formulated by the use of any power, with reduction to relative terms through division by any central position. Cf. Corrado Gini, *Variabilità e mutabilità*, Bologna, 1912, pp. 19, 96, etc. Umberto Ricci, *op. cit.*, p. 50.

[1] Umberto Ricci, *op. cit.*, chap. IV. Ricci defines an Index of Variability, I, as equal to one-half the relative mean deviation.

[2] Corrado Gini, *op. cit.*, p. 21. The mean difference with repetitions, Δ_R, is related to the mean difference without repetitions, Δ, as follows: $\Delta_R = \frac{N-1}{N} \cdot \Delta$.

For the relative mean difference, with repetitions, the following holds: $M.Df\ (Ma) = \frac{\Delta_R}{Ma} = \frac{N-1}{N} \cdot \frac{\Delta}{Ma}$.

[3] Corrado Gini, "Sulla misure della concentrazione e della variabilità dei carattere," *Atti del Reale Istituto Veneto di scienze, lettere ed arti*, Tome 73, part 2, 1913–1914, pp. 1207 ff. $\frac{\Delta}{Ma} = 2R$.

[4] Cf. Corrado Gini, *Variabilità e mutabilità*, pp. 37, 96, etc. L. von Bortkiewicz, *op. cit.*, pp. 207–210; and "Observations," C. Gini, p. 300.

[5] These two coefficients of dispersion are made independent of the unit of measure by the logarithmic treatment itself. Cf. G. U. Yule, "Review of Irving Fisher's 'The Making of Index Numbers,'" *Journal Royal Statistical Society*, Vol. 86, 1923. "As it appears to me, the standard deviation of logarithms is analogous not to the arithmetic standard deviation but to the coefficient of variation" (p. 429).

Comparable to the measures of logarithmic dispersion is R. Gibrat's coefficient of inequality, C (*Les inégalités économiques*, Paris, 1931, p. 89). Since Gibrat concludes that the "law of proportional effect" applies to personal distribution data, he favors the use of the following formula in fitting a line to the data (p. 64):

$$y = \frac{1}{\sqrt{\pi}} e^{-z^2} \quad \text{where } z = a \log (x - x_0) + b.$$

(6) $\sigma_{(\log)}$ = standard deviation using logarithms of attribute values.[2]

(7) α = Pareto's coefficient of inequality; the absolute value of the slope [1] of the line which is obtained by plotting on double log paper the number of persons (ordinate) having income, or wealth, at least as large as a given value (abscissa).[2]

(8) δ = Gini's Index of Concentration; the slope [1] of the line which is obtained by plotting on double log paper the number of persons (ordinate) with an attribute greater than a given amount as a function of the total attribute (abscissa) held by these.[3]

Each of the eight coefficients may be said to measure the departure in distribution of income, or wealth, from a condition of absolute uniformity; yet, in doing so, each emphasizes a different aspect of the inequality phenomenon and effects measurement in a different manner. The dispersion coefficients may be contrasted with α and δ in that the latter are slopes of linear functional relationships between the number of persons and the attribute.[4] Further, α and δ have been employed to indicate the extent of inequality when distribution for the rich alone is available; in fact, the function from which α is derived is not suited to serve as an approximation to distribution among more than the richer element.[5]

The dispersion coefficients may be divided into two classes as to whether they require averaging deviations from a central position or

---

x_o is a constant whose introduction shifts the origin of the x values. The coefficient of inequality is defined: $C = \frac{100}{a}$. If taking logarithms of $(x - x_o)$ renders the distribution normal, it follows that

$$a \log (x - x_o) + b = \frac{\log (x - x_o) - M_{\log (x - x_o)}}{\sqrt{2} \cdot \sigma_{\log (x - x_o)}}.$$

Then, $a = \frac{1}{\sqrt{2} \cdot \sigma_{\log (x - x_o)}}$ and, consequently, $C = 100\sqrt{2}\, \sigma_{\log (x - x_o)}$. In case $x_o = 0$; C becomes a multiple of $\sigma_{(\log)}$ defined in (6).

[1] The procedure employed in determining the values of α and δ in the following pages may be found in F. Savorgnan, "Di alcuni metodi per misurare la distribuzione dei redditi in Austria (1903–1910)," *Bulletin de l'Institut International de Statistique*, Tome 25, 3^{e} livraison, 1931, pp. 333–336. An alternative procedure is explained, pp. 338–340. C. Gini, in *Indici di Concentrazione*, pp. 16–20, gives the same procedures and advises against the method of least squares in fitting a straight line.

[2] Vilfredo Pareto, *Cours d'economie politique*, Lausanne, 1897, Bk. II, part 1, chap. 1; and *Manuel d'economie politique*, Paris, 1909, pp. 390–391. For distributions of wealth, Pareto proposes a modification to his function by adding a constant, a, to the attribute, wealth (*Cours*, p. 310, note). In the following pages the unmodified function is used for both wealth and income distributions. Cf. R. Gibrat, *op. cit.*, pp. 111–115.

[3] Corrado Gini, "Il diverso accrescimento . . .," *loc. cit.*, pp. 70–83 (first statement); and *Indici di Concentrazione*, pp. 16 ff. (a more elaborate presentation). Regarding wealth data, refer to the latter, pp. 73–76.

[4] Corrado Gini, "Observations," *Bulletin de l'Institut International de Statistique*, *op. cit.*, p. 300.

[5] F. R. Macaulay, *op. cit.*, pp. 349 ff.

whether an average difference between each attribute pair is found. Of the two, averaging differences has been preferred by Gini.[1] This procedure assures freedom from the arbitrary choice of a central position from which deviations are computed. When second powers are taken, as in the two cases noted above, the distinction between the deviation and the difference coefficients is not of great importance since the difference coefficients prove to be multiples of corresponding deviation coefficients. The presence of the arithmetic mean in the formulas may be defended on grounds that it represents the attribute magnitude that would obtain under equal distribution. An evaluation of the weight that the larger deviations or differences have in contributing to the degree of inequality is implied in the dispersion coefficients. $V(Ma)$ and $V(S)$, being defined in terms of squares of deviations, accord the larger values greater weight than do $M.D(Ma)$ and $M.Df(Ma)$. By introducing logarithms, as is the case with $M.D_{(\log)}$ and $\sigma_{(\log)}$, the relative weight of the larger deviations is much reduced.

Graphic interpretations for the relative mean deviation and the relative mean difference have been devised. Let p_k represent the per cent of the total number of persons that those individuals constitute who have attribute less than a given amount x. Let q_k represent the per cent of total attribute held by the individuals who have less than the amount x. As x increases, p_k and q_k vary from 0 to 100. A graph of the successive points (p_k, q_k) in the rectangular coordinate field gives the so-called Lorenz curve.[2] In this plot, the line of equal distribution is the straight line drawn from (0, 0) to (100, 100). With an increase in inequality, the Lorenz curve bends farther from the line of equal distribution. The y-intercept of a tangent to the Lorenz curve drawn parallel to the line of equal distribution, taken positively and divided by 100, since percentage figures are used, equals one half the relative mean deviation.[3] When the area between the Lorenz curve and the line of equal distribution is divided by the corresponding area that represents complete inequality, the quotient is half the relative mean difference.[4] This ratio, Gini has called R, the Ratio of Concentration. If the coordinates of the successive points are determined for data in frequency distribution form, and a broken line, not a curve, is drawn through the points, the area between the broken line and the line of equal distribution expressed as a decimal of the maximum area

[1] Corrado Gini, *Variabilità e mutabilità*, pp. 17–20; and "Note," *Bulletin de l'Institut International de Statistique*, *op. cit.*, p. 320, footnote.

[2] M. O. Lorenz, "Methods for Measuring Concentration of Wealth," this JOURNAL, Vol. 9, 1905, pp. 209–219. Cf. C. Gini, "Observations," *op. cit.*, pp. 305–306, and "Note," p. 320G.

[3] G. Pietra, "Observations," *Bulletin de l'Institut International de Statistique*, Tome 25, 3e livraison, 1931, p. 310, also "Note," p. 320M.

[4] Footnote 3, p. 425. Cf. C. Gini, "Note," *loc. cit.*, p. 320G.

gives R'. To compute R' with the aid of a calculating machine the following formula is of service:

$$R' = \tfrac{1}{2}\Sigma(p_{k-1} \cdot q_k - p_k \cdot q_{k-1}) \cdot \frac{1}{5{,}000}.$$

In effect, the formula sums areas of the triangles, any one of which is determined by the origin and two successive observational points.[1] In Tables I, II, and III, R' replaces $M.Df\ (Ma)$.

The following summary of the eight coefficients indicates the aspect of inequality that each measures. The lower and upper [2] limits are given; as inequality increases, the values of a coefficient will diverge from the lower limit.

SUMMARY OF EIGHT COEFFICIENTS OF INEQUALITY SHOWING ASPECT MEASURED AND LIMITS

Coefficient	Symbol	Aspect of inequality measured	Lower limit (equality)	Upper limit (maximum inequality *)
(1) Relative mean deviation, referred to *Ma*	$M.D\ (Ma)$	Deviations from *Ma*, or distance in Lorenz plot	0	$\frac{2(N-1)}{N}$
(2) Relative mean difference, referred to *Ma*	$M.Df\ (Ma)$	Differences between attribute pairs, or area in Lorenz plot	0	$\frac{2(N-1)}{N}$
(3) Coefficient of variation, referred to *Ma*	$V\ (Ma)$	Squares of deviations from *Ma*	0	$\sqrt{N-1}$
(4) Coefficient of variation, referred to *S*	$V\ (S)$	Squares of deviations from *Ma*	0	$\sqrt{\frac{N-1}{N}}$
(5) Mean deviation of logarithms	$M.D_{(\log)}$	Deviations of logs from *Ma* of logs	0	$\frac{2(N-1)}{N} \cdot Ma_{(\log)}$
(6) Standard deviation of logarithms	$\sigma_{(\log)}$	Deviations of logs from *Ma* of logs	0	$\sqrt{N-1}.Ma_{(\log)}$
(7) Pareto's coefficient of inequality	α	Slope of line on double log paper	∞ **	0 **
(8) Gini's index of concentration	δ	Slope of line on double log paper	1	∞

* For coefficients 1 to 4 and 7 and 8, the assumption is made that all attribute is concentrated in the hands of one individual. For coefficients 5 and 6, the assumption is made that all individuals, save one, have a unit of attribute; the rich individual holds the remaining attribute.

** Pareto has stated (*Cours*, *loc. cit.*, p. 312) that a decrease in the value of α points to less inequality. He is corrected in various places, as in, F. Savorgnan, "Di alcuni metodi . . .," *loc. cit.*, p. 332, note; Allyn A. Young, *loc. cit.*, p. 477; Corrado Gini, *Indici di concentrazione*, p. 49.

In measuring the extent of inequality in given distributions, Dalton has concluded provisionally that it is better "not to rely upon the evidence of a single measure, but on the corroboration of several," adding that in most practical cases the five coefficients he recommends

[1] Other formulas are found in B. DeFinetti e U. Paciello, "Calcolo della differenza media," *Metron*, Vol. 8, 1930, pp. 89–94.

[2] Cf. C. Gini, "Sul massimo degli indici di variabilità," *Metron*, Vol. 8, 1930, pp. 3 ff.

"will give results pointing in the same direction, but in some cases they may not do so." [1] With the purpose of analyzing the nature of this suggested corroboration, ten wealth distributions and seven income distributions have been selected for study. It is assumed the ten wealth distributions are comparable in that each exhibits the presence of the same phenomenon, namely, inequality in personal distribution of wealth—this, despite disparity in definition of wealth and person having wealth. A similar assumption is made for the income distributions. The values of the eight coefficients have been computed for the wealth distributions (Table I). Below each coefficient's value appears

TABLE I

COMPUTED VALUES OF EIGHT COEFFICIENTS OF INEQUALITY FOR SELECTED WEALTH DISTRIBUTIONS.* WITH RANKS OF THE DISTRIBUTIONS AS DETERMINED BY EACH COEFFICIENT**

	M.D (*Ma*)	*R'*	*V* (*Ma*)	*V* (*S*)	*M.D* ($_{log}$)	σ ($_{log}$)	α	δ
I—Assets males Australia, '15	1.42 5	.860 6	6.58 5	.989 5.5	.679 10	.767 10	1.36 2	2.72 4
II—Assets females Australia, '15	1.33 2	.820 2	5.17 2	.985 1.5	.610 8	.686 8	1.54 1	2.33 1
III—Wealth U.S., '20	1.09 1	.695 1	5.83 3	.986 3	.340 1	.455 1	1.23 4	3.23 7
IV—Estates France, '09	1.43 6	.860 6	14.8 9	.998 9.5	.660 9	.732 9	1.21 5.5	3.12 6
V—Estates U. K., '07–'11	1.64 10	.906 10	17.1 10	.998 9.5	.381 3	.549 4	1.29 3	2.90 5
VI—Estates men Mass., '59–'61	1.41 3.5	.829 3	6.66 6	.989 5.5	.363 2	.540 2	1.12 7	2.70 3
VII—Estates men Mass., '79–'81	1.55 8	.876 8	8.77 7	.993 7	.403 4	.542 3	1.03 10	3.31 9
VIII—Estates men Mass., '89–'91	1.47 7	.860 6	6.22 4	.988 4	.491 6	.604 7	1.09 8	2.66 2
IX—Estates men Wis., 1900	1.41 3.5	.843 4	5.50 1	.985 1.5	.502 7	.600 6	1.04 9	3.25 8
X—Estates U.S., '12–'23	1.59 9	.893 9	14.5 8	.998– 8	.406 5	.575 5	1.21 5.5	3.55 10

* Data from the following sources:
I and II, G. H. Knibbs, *The Private Wealth of Australia and Its Growth*, Melbourne, 1918, pp. 30–31;
III, W. I. King, "Wealth Distribution in Continental United States," this JOURNAL, Vol. 22, 1927, p. 152;
IV–IX, W. I. King, *The Wealth and Income of the People of the United States*, pp. 87, 89, 68, 68, 69, 76, respectively;
X, Federal Trade Commission, *National Wealth and Income*, 69th Congress, 1st Session, Senate Document No. 126, 1926, p. 58.

** The computed values of Gibrat's coefficient of inequality, *C*, are 128, 115, 120, 141, 155, 145, 156, 148, 122, and 144 with ranks 4, 1, 2, 5, 9, 7, 10, 8, 3, and 6 respectively for distributions I to X.

the rank that is assigned to the distribution when the numerical values found for the ten distributions by any one coefficient are ranked according to the degree of inequality. The distribution exhibiting the

[1] Hugh Dalton, *op. cit.*, p. 16.

least inequality is ranked 1, the distribution exhibiting next to the least inequality 2, etc. Obviously, if there were perfect agreement among the coefficients in adjudging the extent of inequality, the rank assigned to any one distribution would be identical for all the coefficients.[1] A similar table with values of the coefficients and their ranks has been prepared for the income distributions, Table II.

TABLE II

COMPUTED VALUES OF EIGHT COEFFICIENTS OF INEQUALITY FOR SELECTED INCOME DISTRIBUTIONS*, WITH RANKS OF THE DISTRIBUTIONS AS DETERMINED BY EACH COEFFICIENT**

	$M.D\ (Ma)$	R'	$V\ (Ma)$	$V\ (S)$	$M.D\ (\log)$	$\sigma(\log)$	α	δ
I—Income, males Australia, '15	.602 5	.436 6	2.05 2	.890 2	.275 6	.369 6	1.98 2	2.29 2
II—Income, females Australia, '15	1.010 7	.605 7	2.88 3	.945 3	.386 7	.438 7	1.67 5	2.27 1
III—Income, adults Australia, '20	.454 1	.294 1	1.00 1	.707 1	.064 1	.198 1	1.55 6	2.57 4
IV—Income, gain. emp., U. S., '18	.553 3	.382 4	3.68 5	.964 5	.172 5	.271 5	1.80 3	2.48 3
V—Income, U. S. Families, '10	.539 2	.364 2	7.32 7	.992 7	.156 4	.226 3	1.99 1	2.74 5
VI—Income Prussia, '10	.631 6	.404 5	3.17 4	.946 4	.154 3	.237 4	1.53 7	2.97 6
VII—Income U. K., '19–'20	.587 4	.373 3	4.69 6	.978 6	.143 2	.208 2	1.78 4	3.03 7

* Data from the following sources:
I and II, G. H. Knibbs, *op. cit.*, p. 24;
III, Jas. T. Sutcliffe, *The National Dividend*, Melbourne, 1926, p. 45;
IV, National Bureau of Economic Research, *Income in the United States, I*, New York, 1921, p. 136;
V and VI, W. I. King, *The Wealth and Income of the People of the United States*, pp. 233, 225, respectively;
VII, Josiah Wedgwood, *The Economics of Inheritance*, London, 1929, p. 42.

** The computed values of Gibrat's coefficient of inequality, C, are 114, 119, 104, 145, 128, 139, and 143 with ranks 2, 3, 1, 7, 4, 5, and 6 respectively for distributions I to VII.

In determining the values of the coefficients for Tables I and II, no corrections were made for discontinuity in data brought about by frequency distribution classification.[2] But the effect of classification on the ranking of any particular coefficient's values was reduced by using distributions which had a comparable number of classes. This required summarizing the more extensive tables (in doing so, classes showing negative attribute were combined with the lowest positive attribute class—Wealth Distributions I and II). The number of classes of the wealth distributions varied from 12 to 15. Income distributions VI and VII had 8 and 10 classes respectively; the remaining income distributions 13 or 14. Only the richer classes were used in computing the values of α and δ. For wealth data, those richer

[1] For greater detail, ranks may be replaced by reduced values.

[2] Note the corrections Bortkiewicz develops for the relative mean deviation (*op. cit.*, pp. 210–217).

persons who held about 50 per cent of the total attribute were taken; for income data, approximately 20 per cent of the richest people were used in each instance.

From Tables I and II it appears that the expected corroboration among the several coefficients in adjudging the extent of inequality has failed to materialize, since there is little uniformity in the ranking of any one wealth distribution or any one income distribution. If the coefficients α and δ are ignored in Table II, the dispersion coefficients remaining agree in giving first rank to distribution III. But, in ranking the six other income distributions, the dispersion coefficients contradict each other. However, consistency is found in certain sub-groups of the coefficients. $M.D(Ma)$ and R' constitute a consistently acting sub-group, as do $V(Ma)$ and $V(S)$, and $M.D_{(\log)}$ and $\sigma_{(\log)}$. An explanation of the similarity in the rankings of each sub-group of coefficients can be found in the fact that the coefficients comprising a sub-group measure and define inequality in much the same manner. This may be indicated as follows:

$M.D(Ma)$ and R' [or $M.Df(Ma)$]	first powers of deviations or differences; line or area in Lorenz diagram
$V(Ma)$ and $V(S)$	second power of deviations
$M.D_{(\log)}$ and $\sigma_{(\log)}$	deviations of logarithms from arithmetic mean of logarithms

Between α, δ, and the three groups of dispersion coefficients, there is little evidence of consistent uniformity.[1]

Account must be taken of a coefficient's adaptability to available wealth and income data. For Tables I and II, frequency distributions of 8 to 15 classes have been employed; much of the personal distribution materials do not allow this degree of completeness,[2] although in isolated instances more detailed tables are available. An indication of the extent to which the eight coefficients' values are affected by frequency distribution classification of serial data may be seen in Table III. The values of the coefficients for a serial array of the incomes of 100 persons [3]

[1] The computed values of C, Gibrat's coefficient of inequality (Tables I and II, footnotes) give results dissimilar to those obtained from the logarithmic measures of dispersion. This would be expected since the latter are defined without resort to the additional parameter x_0 (footnote 2, p. 425) the introduction of which tends to make C, as a measure of inequality, rely on the particular distribution among richer persons alone, rather than on the distribution among all persons. Nor does it appear that C and any of the other coefficients appraise the extent of inequality similarly.

[2] M. A. Copeland, "How large is our National Income?" *Journal Political Economy*, Vol. 40, 1932, p. 791.

[3] The distribution was synthesized in an impromptu manner from the 1924 figures in *Recent Economic Changes* (M. A. Copeland, "National Income and Its Distribution," chap. 12, p. 835, New York, 1929) supplemented by the general shape of the Lorenz curve of the 1918 data of the National Bureau (*Income in the United States*, I, p. 136). Note that the data deal with distribution of income among "dependent population" and gainfully employed, respectively.

appear in row (1). After the serial data had been thrown in typical frequency distribution form (typical, in that there are 14 income classes, 37 per cent of the total frequency in the lowest income class, and decreasing percentages in each successive class) the values of the coefficients were computed again, row (2). Row (3) shows the change in each coefficient brought about by the classification. In row (5) this change is expressed in terms of the effective range of variation found from Table II by subtracting the smallest value from the greatest value, taking one coefficient at a time. Table III indicates that

TABLE III

VALUES OF EIGHT COEFFICIENTS OF INEQUALITY FOR FICTITIOUS INCOME DATA IN SERIAL ARRAY AND IN TYPICAL FREQUENCY DISTRIBUTION

	$M.D(Ma)$	R'	$V(Ma)$	$V(S)$	$M.D_{(\log)}$	$\sigma_{(\log)}$	α	δ
(1) Serial array	.550	.398	1.26	.782	.229	.317	1.67	1.96
(2) Frequency distribution	.548	.384	1.25	.782	.208	.295	2.13	1.99
(3) Difference, i.e. ‖(1)−(2)‖	.002	.014	0.01	.000	.021	.022	0.46	0.03
(4) Range of variation (Table II)	.556	.311	6.32	.285	.322	.240	.46	.75
(5) Difference / Range, i.e. (3)/(4)	.00 (4) *	.05	.00 (0)	.00	.07	.09	1.00**	.04

* The arithmetic mean is found nearly midway in a class interval, making the difference large rather than small.

** This change is brought about by two influences:

a—When the total frequency is small, the lower class limit of the classified data may vary considerably without altering the frequency of a given class. In the change from serial data, this tends to increase the value of α.

b—For the distribution in question, the values of α_i (see procedure for computing, note 1, p. 426) for the less rich are smaller than for the richest. In finding α for the frequency distribution, fewer of the smaller values of α_i enter into the average which gives α.

with data such as used in this study there is some reason [1] to prefer $M.D(Ma)$, $V(Ma)$, and $V(S)$ to δ and R', which in turn may be preferred to $M.D_{(\log)}$ and $\sigma_{(\log)}$. α is subject to suspicion. In so far as data are available in greater or less detail than has been assumed herein, these tentative findings require modification.

The necessity of selecting a particular coefficient of inequality in place of relying on several coefficients is occasioned by the failure to find agreement between coefficients which are differently constituted. The choice is largely determined by two factors: (1) the completeness of available data, and (2) the tacit assumption that inequality consists in that aspect of personal distribution which a given coefficient measures. Gini and Savorgnan recommend the relative mean dif-

[1] If a coefficient understates the extent of inequality consistently for different frequency distributions, the relative positions of the distributions are scarcely altered by the understatement.

ference and δ.[1] They have emphasized the advantages of δ over α.[2] Gini feels that the relative mean difference will be used widely because of its general applicability.[3] If data permit, Dalton would employ the relative standard deviation, i.e., $V(Ma)$, and the relative mean difference. The fact that $V(Ma)$ has an upper limit of $\sqrt{N-1}$ while a limit such as unity is desirable suggests the substitution of $V(S)$ for $V(Ma)$. $V(S)$, however, shows an actual range of variation for the ten wealth distributions of only 13 points in the third decimal place; perhaps, an alternative formulation, $\frac{S-Ma}{S}$, may prove more suitable than either $V(Ma)$ or $V(S)$; the range of variation for the wealth distributions then becomes 119. On the grounds that the large attribute values should be accorded little weight, $M.D_{(\log)}$ and $\sigma_{(\log)}$ may find justification. However, the selected frequency distributions are none too complete for this logarithmic treatment.

[1] Corrado Gini, "Observations," *loc. cit.*, p. 299; F. Savorgnan, "Observations," *loc. cit.*, p. 307.

[2] As in: Corrado Gini, *Indici di concentrazione, op. cit.*, pp. 48–49; F. Savorgnan, "Di alcuni metodi per misurare . . .," *loc. cit.*, pp. 332–333. Bortkiewicz asserts that α is not suited to serve as a measure of inequality (*loc. cit.*, p. 222).

[3] Corrado Gini, "Observations," *loc. cit.*, p. 299.

NOTES

A TEST FOR SIGNIFICANCE IN A UNIQUE SAMPLE

By A. E. Brandt, *Iowa State College*

If $d_1, d_2, d_3, \ldots, d_n$ are the differences between n observations on the response of two organisms to the same treatment or on the effect of two treatments on the same organism, and if these differences represent all of the available data, Fisher's t-test [1] may be used to test whether the mean of the differences is significantly different from zero.

Frequently, however, quantitative data are lacking, that is, the differences are recorded as plus, minus or zero, or, though quantitative data are given, an easily computed approximation will suffice. In such cases the accompanying chart may be used conveniently and with a small amount of calculation. It is based on the binomial, $(p+q)^n$, and the familiar test for the significance of a mean difference, the ratio of the mean difference to its standard deviation.

In using this approximate method, the differences are taken so that the plus ones shall be in excess. The variables have been designated as follows:

p_o = observed proportion of plus differences.
p = expected proportion of plus differences.
q = $1-p$.
n = number of differences observed.
N_1 = number of differences for highly significant (1 per cent) point.
N_5 = number of differences for significant (5 per cent) point.
σ = $\sqrt{Npq}$.

Of these, only p_o must be calculated. The formula is

$$p_o = \frac{\text{number of plus differences plus half the number of zeros}}{\text{total number of differences}}.$$

If the two organisms are expected to react alike or if the two treatments are expected to have the same result, $p=q=.5$. Under these conditions

$$\sigma = \sqrt{N(.5)(.5)} = .5\sqrt{N}.$$

The difference between the observed number of successes and the expected number is

$$Np_o - N(.5) = N(p_o - .5).$$

[1] R. A. Fisher, *Statistical Methods for Research Workers*, 4th edition, Oliver and Boyd, London, 1932.

The ratio of this difference to its standard deviation is

$$\frac{N(p_o-.5)}{.5\sqrt{N}}=x$$

which reduces to

$$\sqrt{N}(p_o-.5)=.5x.$$

In Table 1 of Fisher (1932), the value of x for the highly significant (1 per cent) point is 2.576, and for the significant (5 per cent) point it is 1.960. These values substituted in the above equation give for the 1 per cent point

$$\sqrt{N_1}\,(p_o-.5)=1.288$$

or, taking logarithms of both sides,

$$.5\log N_1+log\,(p_o-.5)=0.1099 \qquad (1)$$

and for the 5 per cent point

$$\sqrt{N_5}\,(p_o-.5)=0.980$$

or

$$.5\log N_5+\log\,(p_o-.5)=-0.0088. \qquad (2)$$

The accompanying chart, then, is simply an alignment chart based on equations (1) and (2). The logarithms of $(p_o-.5)$ for values of p_o from 0.55 to 1.00 are plotted on the first line but the values of p_o instead of $(p_o-.5)$ are shown. The logarithms of the square roots of N_1 and N_5 are plotted on the second and third lines respectively, recording the values of N_1 and N_5 instead of their square roots. If a straight edge is placed on any value of p_o at a right angle to the three parallel lines, the corresponding values of N_1 and N_5 can be read at its intersection with the second and third lines.

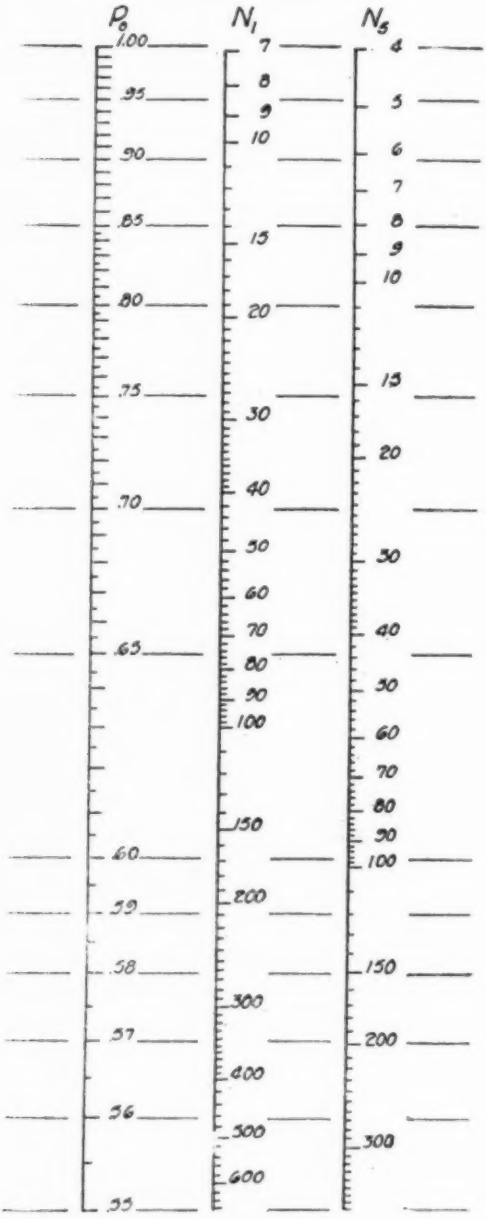
The Criterion of Significance: If n is equal to N_1 there is but one chance in a hundred that as great a proportion of success as that observed could have been secured on the basis of chance alone, that is, the difference is highly significant. If n is equal to N_5, there are not more than 5 chances in a hundred that as great a proportion of successes as that observed could have been secured on the basis of chance alone, or the difference is significant.

Examples:

(a) In 648 coöperative yield tests of Kanred and Turkey winter wheats made in Kansas,[1] Kanred outyielded Turkey 429 times and

[1] S. C. Salmon, *The Point Binomial Formula for Evaluating Agronomic Experiments*, 22: 77–81, 1930.

NUMBER OF OBSERVATIONS NECESSARY FOR A SIGNIFICANT (N_5) OR HIGHLY SIGNIFICANT (N_1) MEAN DIFFERENCE FOR VARIOUS VALUES OF P_c.



there were 6 ties. To test the significance of the difference in yielding power of these two wheats by means of the chart, proceed as follows:

$$n = 648$$

$$p_o = \frac{429 + (6)(.5)}{648}$$

$$= 0.6667.$$

The value of N_1 corresponding to $p_o = 0.6667$ on the chart is 36. Since 648 is greater than 36 (n greater than N_1) there is less than one chance in a hundred that Kanred could have outyielded Turkey in the observed proportion of cases on the basis of chance alone. In other words, the difference is highly significant.

(b) Fisher (1932) quotes, from Student's paper, Cushny and Peebles' data on the difference in sleep producing quality of the optical isomers of hyoscyamine hydrobromide. Ten patients were used and the effect was measured in hours of sleep gained by the use of each isomer. Nine of the ten patients gained more hours of sleep from the use of the levo- than from the dextro- and the tenth case was a tie. In this case

$$n = 10$$

$$p_o = \frac{9 + .5}{10}$$

$$= 0.95.$$

The value of N_1 corresponding to $p_o = 0.95$ on the chart is 8. Since 10 is greater than 8 (n greater than N_1) the difference in effect of the two isomers is highly significant. This conclusion agrees with that of Fisher which he based on the actual values of the differences instead of on their signs only.

Charts can easily be constructed for other expected proportions of successes. In genetics, especially, observed phenotypic ratios could be compared very readily with such theoretical ratios as 3 to 1, 9 to 7, 15 to 1 and others after suitable charts had been prepared.

THE CENTRAL STATISTICAL BOARD

On July 27, 1933, by executive order of President Roosevelt a Central Statistical Board was established "to appraise and advise upon all schedules of all government agencies engaged in the primary collection of statistics required in carrying out the purposes of the National Industrial Recovery Act, to review plans for tabulation and classification of such statistics, and to promote the coordination and improvement of the statistical services involved."

The members of the Board are:

Winfield W. Riefler, *Chairman*, and Economic Adviser to the Executive Council.

Oscar E. Kiessling, *pro tem*, Chief Economist of the Mineral Statistics Division, Bureau of Mines.

Mordecai Ezekiel, Economic Adviser to the Secretary of Agriculture (Louis H. Bean, Economic Adviser to the Agricultural Adjustment Administration, alternate).

John Dickinson, Assistant Secretary of Commerce (William L. Austin, Director of the Bureau of the Census, alternate).

Isador Lubin, Commissioner of Labor Statistics.

E. A. Goldenweiser, Director of Research and Statistics, Federal Reserve Board.

Alexander Sachs, Chief of Division of Economic Research and Planning, National Recovery Administration.

Meredith B. Givens, Executive Secretary of the Committee on Government Statistics and Information Services.

E. Dana Durand, Chief Economist, Tariff Commission.

Corrington Gill, Director of Research and Statistics, Federal Emergency Relief Administration.

Stuart A. Rice, Assistant Director, Bureau of the Census.

W. R. Stark, Chief of Section of Financial and Economic Research of the Treasury Department.

O. C. Stine, Chief of Division of Statistical and Historical Research, Bureau of Agricultural Economics.

Although the work of the Board is limited to statistics bearing on recovery, the Board may be regarded as the successor of the recently dissolved Federal Statistics Board, which itself succeeded the war-time Central Statistical Bureau. Like the Federal Statistics Board, the new Board has advisory powers only. It will not itself engage in the collection, compilation, or analysis of data. It will, however, have a small staff to make investigations as a basis of the Board's recommendations, headed by the Board's Executive Secretary, Morris A. Copeland.

The scope of the activities of the Board is reflected in the Committees of the Board of which there are eleven to date, as follows: Nominations; Common Interests of the Census, National Recovery Administration, and the Bureau of Labor Statistics; Reporting of Statistics Under Codes of Fair Competition; Construction Statistics; Review of Schedules and Tabulation Proposals; Maintenance of Statistical Services; Unemployment Statistics; Central Tabulation; Retail Price Statistics; Budget and Procedure; Mortgage Statistics.

The Office of the Board is at Room 7028 in the Commerce Building.

COMMITTEE ON GOVERNMENT STATISTICS

The Committee on Government Statistics and Information Services, appointments to which for the quarter ending September 30 were made jointly by the President of the Association and the Executive Director of the Social Science Research Council, has been reconstituted for the autumn quarter of 1933. Willard L. Thorp and Stuart A. Rice, members during the summer quarter, have accepted appointments to government positions, the former as Director of the Bureau of Foreign and Domestic Commerce and the latter as Assistant Director of the Census. They have, therefore, not been continued as Committee members.

The reconstituted Committee, subject to possible further appointments, consists of Edmund E. Day, *Chairman*, Meredith B. Givens, *Executive Secretary*, Donald Belcher, John D. Black, Robert E. Chaddock, Morris A. Copeland, W. L. Crum and Bryce M. Stewart. The members of the Washington staff of the Committee now include: Viva Boothe, Ewan Clague, John H. Cover, Morris A. Copeland, Edward R. Gray, Meredith B. Givens, William M. Hoad, Joseph B. Hubbard, Murray W. Latimer, Jacob Perlman, George W. Stocking, Tracy E. Thompson, Sydney W. Wilcox, and Helen Wright. Mr. Clague has been added to the Advisory Committee to the Secretary of Labor, which is affiliated with the Committee on Government Statistics. M. R. Benedict of the Giannini Foundation of the University of California will join the staff on October 2, to represent the Committee in the field of agricultural statistics.

In addition to the above, others who have served the Committee for limited periods of time include the following: Frederick J. Dewhurst, Constant Southworth, Margaret Clem, Edna Lonigan, Hilding Anderson, Woodlief Thomas, Warren Thompson. The Committee now has the advantage of the active advice and counsel of its chairman, Dr. Edmund E. Day, who has recently returned from abroad.

The Committee on Government Statistics is represented on the Central Statistical Board by Meredith B. Givens. The services of Morris A. Copeland have been loaned by the Committee to the Board to enable him to serve the latter as its Executive Secretary. A full report of the work of the Committee during the first two quarters of its activity will be presented at the annual meeting of the Statistical Association at Philadelphia in December.

A substantial fraction of the Committee's task has been concerned with the work of the affiliated Advisory Committee to the Secretary of Labor, of which Bryce M. Stewart is Chairman. Several members of the resident staff are members of this Committee, and have given full time service to problems within its special field. In addition, invaluable service has been rendered by non-staff members of the Advisory Committee, including Miss Aryness Joy, Mr. Howard B. Myers, and Mr. Ralph G. Hurlin. (Written September 15, 1933.)

THE NATIONAL RECOVERY ACT AND RETAIL PRICES

A dinner meeting of the American Statistical Association was held on Tuesday evening, October 10, 1933, at the Roger Smith Restaurant on 41st Street near Madison Avenue, New York City. One hundred and seventeen persons were present. Dr. W. W. Cumberland of Wellington and Company, presided. The general topic for discussion was The National Recovery Act and Retail Prices.

The first speaker of the evening was Dr. Oswald Knauth, Treasurer of R. H. Macy and Company. He began by discussing the price fixing rules which are being proposed for insertion in a number of the codes governing the retail industries. It is proposed, for example, to prohibit retailers from selling articles below a figure representing cost plus a certain percentage of cost. It is also proposed to forbid the sale of standard trade-marked goods at a price more than 21 per cent below that figure set by the manufacturer of the article as the standard retail price. The avowed intent of these restrictions is to prevent "predatory price cutting." Unfortunately, it does not seem possible to determine just when price cutting becomes "predatory." The fact is that one merchant can sell goods at a rate lower than another merchant and still not lose money in the process, provided his costs of doing business are lower. Merchants do, indeed, often sell goods below cost. Obviously, this procedure cannot be carried far without bankrupting the merchant who employs it. As a matter of fact, such below-cost sales are usually small in volume and are resorted to only for purposes of attracting customers into the store. This is merely a form of advertising which, if indulged in to a limited extent, may be profitable, and is as legitimate as any other means of attracting trade. The logic of attempting to eliminate this practice is, then, decidedly open to question.

If a serious attempt is made to enforce the provision requiring that all goods be sold at cost plus a certain profit percentage, many difficulties are sure to be encountered. Retail business operates on the principle of an average mark-up for a whole class of merchandise. The merchant does not know how much it costs him to handle any particular article. Furthermore, the number of different articles carried is usually so large as to make it impracticable to estimate the cost involved in handling any single item. If the merchant himself does not know the real cost of an article, how can it be determined by the regulative authorities?

It is to be remembered, also, that bankrupt stocks of merchandise are often purchased at prices far below the cost of reproducing the articles. How is the regulator to know what the merchant paid for each article? If the enforcing officials are required to study intensively the cost of each of the hundreds of thousands of separate articles carried by the various merchants, how long will it take to cover all the mercantile establishments in the United States?

Another fact to be kept in mind in connection with the proposal to fix re-sale prices of trade-marked articles is that the Supreme Court of the United States might not be sympathetic to such action. Decisions of the courts up to the present time have tended to the view that manufacturers have no legal right to

fix the retail prices on their products unless they themselves do the retailing. Even if merchants are effectively prevented from selling trade-marked articles below the prices set by the manufacturers, how will it be possible to prevent merchants from evading the law by utilizing such devices as giving special privileges, rebates, or premiums? If the law were actually enforced, would not the chief net result be to cause the merchants to deal in non-trade-marked articles which could be sold to the public at prices lower than those which it would be necessary to charge for the trade-marked varieties?

One point that should never be lost sight of is that the consumer must ultimately pay any added costs which result from regulations of the type just mentioned. Wage earners are consumers as well as producers. In their function as consumers, they will suffer from higher prices just as much as do other classes of buyers.

It must be remembered also that any regulation which increases the cost of doing business and hence raises the prices of articles offered for sale almost inevitably results in a curtailment in the purchases of these articles. If fewer articles are sold, production of these articles will decline, and this reduction in the volume of output will add to the amount of unemployment.

At the close of Dr. Knauth's address, Dr. Cumberland took occasion to state that business men usually agree that the whole theory of price fixing is normally unsound from the economic standpoint. Even so, most of these same business men urge that the Government intervene to keep up the prices of the particular articles which they themselves have for sale.

The second regular speaker of the evening was Mr. Edward L. Bernays, Public Relations Counsel. He spoke on the subject, "The Moulding of Public Opinion." Mr. Bernays pointed out that the National Recovery Act has been designed to bring about a common understanding between labor, the employers, and the consumers. In order to persuade all branches of industry and all of the interests in these industries to coöperate fully, the Government has found it necessary to engage in an active campaign of propaganda. At the same time, most of the groups interested have coupled with the Government propaganda a large amount of propaganda designed to gain support for their own special interests.

Forecasters, in making their calculations, usually consider it unnecessary to consider propaganda. If, however, they are to attain success in their prophecies, they will do well to take cognizance of the propaganda work which is being done. For example, after a serious train wreck, the manufacturers of steel cars may start a campaign to abolish wooden cars. If this campaign is successful, the whole car manufacturing industry may be greatly affected. In recent years, advertising has carried the public first to one food and then to another. These resulting changes in the eating habits of the people have affected greatly the welfare of certain classes of the farm population, for if people eat more of one food they will eat less of another and one set of producers gains at the expense of the other.

The successful propagandist must take advantage of the basic impulses and prejudices of the population or else he will meet with little success. Since individuals generally look for leadership to the outstanding men in the social groups

with which they happen to be affiliated, propaganda, to be successful, must receive endorsement from these key men. Furthermore, the successful propagandist usually knows how to employ effectively catchy phrases of one kind or another. For example, one of the things which apparently has given great advantage to the "wets" in recent years has been that their propagandists have succeeded in coupling in the public mind the word "racketeer" with the word "prohibition." At present, there are many types of media which are used to influence public opinion. Among such types may be mentioned the following: newspapers, books, billboards, telegrams, radios, churches, Chautauquas, women's clubs, Lion's clubs, Rotary clubs, and motion pictures.

In introducing the next speaker, Dr. Cumberland called attention to the fact that Mr. Zelomek, at a meeting in 1932, had forecast the movement of retail prices during the coming year. At that time, there were many who doubted greatly the accuracy of Mr. Zelomek's forecasts. His accuracy is probably ascribable not to mere luck but primarily to his careful analysis of the facts at hand.

Mr. Zelomek began his address by remarking that, in his opinion, most statisticians, in predicting the future, qualify their statements with so many "ifs" and "buts" that it is impossible to tell what they mean. He promised to be specific. In carrying out this program he began by stating that, although retail prices have already risen materially, they are destined to go much higher. The probabilities are, however, that the advance during the next six months will be at a rate less than the advance during the last six months. Nevertheless, by April 15, 1934, prices of men's clothing will be at least one-third higher than at present, and retail prices in general, as indicated by the Fairchild index, will stand approximately 50 per cent above their 1932 low. The chances are that, by next autumn, retail prices will be higher than they were in 1923.

Retail prices are destined to advance because of the fact that they are arrived at by marking up wholesale prices, and wholesale prices have already advanced much more than retail prices. Furthermore, the Administration is tied up to a policy of pushing up the prices of raw materials. If this is done, it will necessarily mean that retail prices will go still higher. For a long time now, prices of finished products have been too low to enable industries to operate on a profitable basis while the existing level of costs is maintained. The consumer has been profiting at the expense of the employer, and also at the expense of the producer of raw materials.

At present, there is a widespread belief that retail prices will not go up because it is assumed that retailers are now overstocked with goods purchased because of the threat of inflation. The truth is, however, that such overpurchasing is almost entirely mythical. Most retailers have been unable to increase their stocks, for, to do so, requires additional credit, and, for many months now, it has been impossible for the average merchant to secure additional credit.

Mr. Zelomek concluded by pointing out that the movements of retail prices are of great consequence to those members of the population who depend upon fixed incomes. Every rise in retail prices is injurious to this class of the population.

At the close of Mr. Zelomek's remarks, the Chairman expressed regret that Mr. Zelomek had failed to call attention to the fact that higher prices would mean a smaller volume of sales and that this reduction in volume of trade might affect the public very adversely.

The last regular speaker of the evening was Mr. Paul T. Cherington, Distribution Consultant. He began by commenting upon the mythical belief, now widely held, that advertising dominates the consumers to such an extent that they no longer have any freedom of choice in their purchases. He stated that those concerns which spend millions of dollars upon advertising wish heartily that this belief corresponded to the facts. The truth is that advertisers are often painfully ignorant as to what the results of their advertising will be. In many instances, the consumers fail to follow in the manner expected, the lead given. This fact was recently impressed forcefully upon a manufacturer of tooth paste who had persuaded many retail druggists to set up elaborate window displays advertising his product. Investigation proved that these window displays did result in increased sales of the tooth paste in question, but that most of the increase occurred in the cut-rate drug stores, while the regular priced drug stores gained practically nothing by putting the displays in their windows. Buyers are still inclined to follow the wise practice of not mixing charity with business —hence they buy where the goods may be obtained cheapest.

Of course, the public is interested not only in the price but also in the type of goods offered. In this connection, style plays as important a part as quality. The retailer wins who is more successful than his competitors in guessing what the public is going to want. Many merchants guess badly and are soon out of business.

In answer to an inquiry, Dr. Knauth pointed out that the manufacturer as well as the retailer must cater to the whims of the public. Production and merchandising must both be looked upon as reflections of these whims.

Mr. Bernays pointed out that the present campaign to "Buy Now" is sound only in so far as it is predicated on the assumption that prices will be higher in the near future.

Mr. Zelomek said that the public have already been subjected to so many "Buy Now" campaigns that they have become extremely skeptical of all predictions that prices are going higher. Furthermore, the grim fact remains that people cannot buy if they do not have the money. The poorer classes can, therefore, buy more only if their incomes are increased by fuller employment or higher wages.

Several of the speakers who followed emphasized the fact that purchasing of goods has fallen off during recent years, not because consumers have been unwilling to buy, but because their incomes have been seriously impaired both by unemployment and by losses incurred through investments or speculation. Only the limited number of consumers who have had unimpaired incomes have profited by the low prices which have prevailed. The great shortage of buying has been mainly in the realm of production goods and raw materials—purchases of consumers goods having held up fairly well.

One speaker emphasized the fact that the proposed code provision forbidding

sales on a margin of less than ten per cent profit will affect but a very small proportion of retail business, for most sales are made at much higher margins. Another speaker held that the whole aim of the National Recovery Act program is to keep all present retailers in business. It would be far better for the public if the inefficient retailers were driven out of the field.

In response to a question from the Chairman, Willford King pointed out that, if the present campaign to raise wages is followed by an increase in retail prices, the labor unions will promptly demand that wages be raised still higher. If this is done, employers will be unable to continue in business unless they can sell their products at higher prices. The only way to keep up wage rates and yet secure higher prices for the products will be to inflate the currency. If inflation brings higher retail prices, there will then be a demand for higher wages, and so on indefinitely. Such demands in other countries have often led to a program of inflation which has ruined all classes. While the elevation of prices to the level prevailing between 1922 and 1929 is highly desirable, such a procedure should be undertaken upon a purely scientific basis and under the most rigid control.

The fixing of individual wages and individual prices in a competitive field has been attempted at many times and places, but has almost never produced the results expected by the authorities responsible for the price fixing. In most cases, the outcome has been highly unsatisfactory.

The whole idea of attempting to regulate the details of the entrepreneur's business is repugnant to American ideals of individual freedom. To carry out such a policy effectively means that one-half of the nation must be trained to spy upon the other half. Is this the vocation which we desire to cultivate?

The discussion was closed by Dr. Charles G. Smith. He called attention to the fact that price fixing, while new in the thoroughly competitive field, has long been in vogue in those branches of industry dominated by monopolies or "affected with a public interest," as for example, railroads, public utilities, and insurance companies. In these fields, the regulating officials have been subject to much pressure and many difficulties have arisen. For example, the public has always clamored for lower rates, regardless of the cost of doing business. Nevertheless, regulation has, in many respects, worked satisfactorily.

WILLFORD I. KING, *Secretary*

PROGRESS OF WORK IN THE CENSUS BUREAU

THE PRINTING SITUATION

Without drawing upon the Bureau's limited printing allotment for the current year, sufficient funds have now been procured to complete the printing of the remaining eight volumes of the Fifteenth Census Reports referred to in the September issue of the JOURNAL. The editions will be limited to 1,000 copies each. There will remain, however, a number of studies based on the Fifteenth Census which are completed in manuscript ready to go to the printer and for which no funds are available and none in prospect.

The estimated cost of the printing which in regular course ought to be done

in the current fiscal year, 1933–34, was $86,000. The total amount allotted to this Bureau was only $45,000. After deducting the cost of job work and of printing the necessary schedules, the amount remaining for the printing of the reports is only about $21,000, or hardly more than one-third the amount allocated to that purpose under the original estimates.

In order to meet this serious situation radical reductions had to be made in the printing program, as shown by the following statement:

Reports	Funds for printing as allocated under:	
	Original estimates	Amount actually allotted
Annual Report of the Director	$125.00	$55.00
Mortality Statistics: 1930 (annual)	*4,689.84	4,589.00
Birth Statistics: 1930 (annual)	*9,327.18	9,127.18
Financial Statistics of States: 1931 (annual)	*291.43	291.43
Financial Statistics of Cities: 1931 (annual)	*10,503.92	.....
Financial Statistics of State and Local Governments, 1931 (decennial):		
State Bulletins	*5,786.79	.....
Digest of State Laws, 1932 (state bulletins)	3,653.71	.....
Census of Manufactures: 1931 (biennial)	*13,004.07	779.03†
Clay and Refractory Products (annual)	271.99	.....
Paper and Paperboard (annual)	190.00	.....
Lumber, Lath, and Shingles (annual)	325.00	.....
Electrical Industries, 1932 (quinquennial):		
Electric Railways	2,647.18	
Central Electric Light and Power	989.38	3,000.00‡
Telephones	769.53	
Telegraphs	230.14	
Animal and Vegetable Fats and Oils (annual)	402.44	119.22
Cotton Production in the United States (annual)	986.69	473.28
Cotton Production and Distribution (annual)	1,885.74	.....
Defective, Dependent, and Delinquent Classes, 1931 (decennial):		
Prisoners	1,468.53	1,468.53
Mental Patients in State Hospitals	1,459.55	1,531.47
Feeble-minded and Epileptics	682.00	
Total—publications	$59,690.11	$21,434.14

* Balance remaining after paying first charges.

† Provides for printing only 19 industry reports and a summary for all industries, in addition to the 11 which were printed in the previous fiscal year. The original estimate provided for printing 66 reports (in addition to the 11 already printed) of which 25 were in proof and the remaining 41 in manuscript ready to go to the printer prior to July 1, 1933.

In view of this situation the Census Advisory Committee, at the meeting held in Washington on September 22 and 23, adopted the following resolution:

> The Census Advisory Committee is greatly concerned to learn that owing to the fact that the funds allotted for printing are about 50 per cent below the amount asked for and estimated as necessary, the Bureau has been compelled to abandon or postpone indefinitely the printing of some of the reports which will be completed ready for publication in the current fiscal year and to curtail very materially the scope and detail of others. It is obvious that in so far as the statistics which the Bureau compiles and tabulates can not be printed, the money expended on their collection is wasted. Either the Bureau should be provided with funds sufficient to print the results of the statistical compilations which it is authorized or directed by law to make, or else the scope of such compilations should be reduced to come within the limits imposed by the funds that will be available for printing the results.
>
> The Committee therefore recommends that steps be taken to secure, if possible, supplementary funds for printing the current reports; and looking to the future that an organized effort be made to do away with the present practice of making a separate appropriation for printing as applied to the work of the

Census Bureau and include the cost of printing in the appropriation granted directly to the Bureau for carrying on the statistical inquiries which it may be authorized or directed by law to make.

CENSUS OF MANUFACTURES

In making plans for the biennial census of manufactures covering the year 1933, the Bureau is confronted by the fact that there is very little money available for field work, so that unless funds can be provided sufficient for that purpose the census will have to be taken largely by mail. The data for the biennial census are regularly obtained by use of one general and a large number of special schedules, the latter covering the same inquiries as the general schedule with respect to total value of products, number of wage-earners, cost of materials, etc., but specialized for each industry with regard to details of products, materials, and machinery, peculiar to that industry. At the 1933 Census it is proposed to limit the use of the general schedule and the special industry schedules to that group of the larger establishments in each industry which contributed, at the census for 1931, approximately 90 per cent of the total value of products of the industry. The remaining establishments are to be canvassed by means of a short-form schedule which will call for only certain basic data. This short-form schedule will go to between 60 and 70 per cent of the establishments covered by the census, although the proportion receiving it will not be the same in all industries. This method of making the canvass will not greatly reduce the proportion of products for which detailed statistics can be given, but will reduce materially the work of tabulating the data and, for the smaller establishments, will lighten the burden of preparing their returns.

It is proposed that the period covered by the census shall in all cases be the calendar year, which for the great majority of manufacturing establishments is the business or fiscal year. Where that is not the case, the Bureau has heretofore accepted the business or fiscal year ending at any date prior to March 31. This has resulted in a delay of three months in receiving the reports from certain firms. It is believed that it will not be very difficult for these firms to supply the desired information for the calendar year, thus expediting the publication of the results of the census.

Looking to the future, it is proposed to do away with the biennial census of manufactures and in place thereof have an annual census of limited scope and a complete and comprehensive quinquennial census. This will require enabling legislation, which the Bureau hopes to obtain. The quinquennial census would seem to belong in the year 1934, this being the year midway between the decennial censuses of 1929 and 1939, but it may be decided to shift the decennial year for the census from 1939 to 1938, accept the 1933 biennial census as the equivalent of a quinquennial census, begin the annual censuses with 1934, and have the first complete quinquennial census to cover the year 1938. With these possibilities in mind it is proposed to begin a revision of the special industry schedules with a view to adapting them for the purposes of an annual census for 1934.

CENSUS OF WEALTH, DEBT, AND TAXATION

As stated in the June issue of the JOURNAL, the Bureau of the Census began publishing the results of the decennial compilation of financial statistics of state and local governments, formerly known as the census of wealth, debt, and taxation, in a series of state bulletins or reports under the title "Financial Statistics of State and Local Government, 1931." Only three of these state reports have now been printed. Twenty-four more are completed in manuscript ready for printing and the others will probably be ready before February 1. But owing to the deficiency referred to in the allotment for printing, the publication of these reports has been suspended with little prospect of its being resumed before the next fiscal year, which begins July 1, 1934.

REGISTRATION AREA COMPLETED

The admission of the state of Texas to the birth and death registration area means that for the first time the registration of deaths and births in the United States is complete, covering every state and the District of Columbia, and that the Director of the Census who is charged with the responsibility of compiling statistics of births and deaths will now be able for the first time to announce a death rate or birth rate for the United States without resorting to estimates for states not within the area. It means also that the machinery has been set up and is in successful operation for registering every death and every birth in the United States as it occurs, recording the disease, accident, or violence that caused the death, also the age, sex, nativity, conjugal condition and occupation of the decedent; or in case of a birth, the sex of the child, and the age, color, nativity, and occupation of the father and of the mother, the total number of children born to the mother, and other data, thereby furnishing the basis for the collection of complete vital statistics covering the entire country. To bring about this result has taken more than thirty years of organized and persistent effort on the part of the Bureau of the Census assisted by the American Public Health Association, the National Tuberculosis Association, and a special committee representing the principal insurance companies.

DIVISION OF STATISTICAL RESEARCH

The Bureau has recently established a Division of Statistical Research to have charge of the preparation of monographs, make studies of technical problems arising in connection with the regular work of the Bureau, consider plans for improving the form of statistical presentation in the Census Reports and undertake similar tasks. This division has been placed in charge of Joseph A. Hill as Chief Statistician. For the time being, and until the Bureau has more ample funds, the work of this division will be limited to what can be accomplished by the Chief Statistician and two or three assistants.

WORK FOR OTHERS

The work of the Bureau of the Census is being extended in various directions beyond the statistical inquiries which it regularly conducts and for which it is responsible. It is making numerous statistical tabulations for the N.R.A., and

also for trade associations, using funds provided by these organizations for that purpose; it is tabulating the results of the cost-of-living inquiry conducted by the Bureau of Labor Statistics in the District of Columbia; and through its Cotton Field Service it is collecting certain statistical data for the Agricultural Adjustment Administration. A recent order by the Secretary of Commerce directs the centralization of all tabulating activities falling within the Department of Commerce in the Bureau of the Census.

J. A. H.

MISCELLANEOUS NOTES

Calendar Reform Committee.—The Committee on Calendar Reform of the American Statistical Association held an emergency meeting at N.R.A. headquarters in Washington September 20, 1933. The committee convened at the suggestion of Dr. Stuart A. Rice, President of the Association and a member of the Central Statistical Board, the newly created coördinating body for the Government's permanent and emergency statistical agencies with relation to the recovery program. The emergency arose in connection with the problem of determining a uniform reporting period for employment, pay-roll, man-hour, production and other data from industries under the Codes.

The Committee unanimously adopted the following recommendation which was formally presented to the Central Statistical Board on September 13, 1933, by the Committee chairman, Mr. M. B. Folsom:

"It is recommended that the current statistics of industry and trade relating to employment, pay-roll, production, and other data used as a measure of the volume of business activity should be reported for periods of one week, two weeks or four weeks, with the object of making possible comparisons on a four week basis; it being understood that in the case of certain industries, or fields of activity exceptions to this practice may be appropriate."

The Calendar Reform Committee is composed of the following, all of whom attended the meeting:

Chairman, M. B. Folsom, Assistant Treasurer, Eastman Kodak Company, Rochester, New York.

Dr. C. F. Marvin, Chief of the Weather Bureau, Department of Agriculture, Washington, D. C.

Dr. S. L. Andrew, Chief Statistician, American Telephone & Telegraph Company, New York City.

Professor H. S. Carter, University of Pennsylvania, Philadelphia, Pennsylvania.

Professor A. H. Hedrich, Department of Bio-Statistics, The Johns Hopkins University, Baltimore, Maryland.

Dr. Julius Parmelee, Director, Bureau of Railway Economics, Washington, D. C.

Dr. W. J. Donald, formerly managing director of The American Management Association, now Executive Vice-President, Packaging Machinery Manufacturers Institute, 52 Wall Street, New York City.

R. P. Towne, Assistant Treasurer, National Blank Book Company, Holyoke, Massachusetts.

Dr. E. Dana Durand, Chief Economist, Federal Tariff Commission, Washington, D. C.

Meredith N. Stiles, *Secretary*, Rochester, New York.

Present at the meeting, in addition to members of the Committee, were Stuart A. Rice, J. B. Hubbard, and Viva Boothe of the Committee on Government Statistics, Andrew T. Court, of the National Recovery Administration, and A. H. Robinson, Statistician of the Eastman Kodak Company.

The Committee also discussed the broader phases of calendar reform and a subcommittee was named to draft an inclusive report for discussion at subsequent meetings.

The secretary of the Committee is remaining in Washington to consult representatives of trade groups with respect to the application of the Committee's recommendations to their industries.

Business Statistics Section of the Cleveland Chapter.—The first fall meeting was held at the Chamber of Commerce Club on Monday, September 25. Officers for the coming year were elected. Mr. K. H. MacKenzie of the Cleveland Federal Reserve Bank was elected Secretary, Mr. E. A. Stephen of The Ohio Bell Telephone Company as Chairman. Following the election of officers, the Group made its semi-annual forecast of the Annalist Index of Business Activity. Each forecaster explained the reasons for his projection. Meetings on the last Monday of every month are planned for the season.

The Los Angeles Chapter.—A summer dinner meeting was held in conjunction with the Southern California Economic Association on July 19, 1933. The speakers of the evening were Dr. Thomas Nixon Carver of Harvard University and Dr. George W. Dowrie of Stanford University, who spoke on "Current Economic Trends."

The Philadelphia Chapter.—On January 13 a dinner was given by the Philadelphia Statistics Group in honor of Dr. Stuart A. Rice on the occasion of his election to the Presidency of the American Statistical Association. Dr. Rice talked to the Group about his work with the President's Committee on Social Trends.

At this meeting the Group voted to reorganize as the Philadelphia Chapter of the American Statistical Association, a Committee being appointed to prepare plans for an organization meeting.

The Chapter organization meeting followed on March 31. At this meeting Dr. S. S. Kuznets of the National Bureau of Economic Research and the University of Pennsylvania discussed "Problems of Measuring the National Income."

The officers of the new Chapter are: President, W. J. Carson, Assistant Professor of Finance; Vice-President, Ewan Clague, Research Director, Community Council of Philadelphia; Secretary-Treasurer, H. S. Davis, Industrial Research Department, University of Pennsylvania.

Members of Executive Committee: J. Parker Bursk, Assistant Professor of Statistics, University of Pennsylvania; Casimir A. Sienkiewicz, Statistician, Philadelphia Federal Reserve Bank.

The first meeting of the Philadelphia Chapter following its organization in March was held on May 26. At this meeting Dr. O. E. Baker, Senior Agricultural Economist with the Department of Agriculture, Washington, discussed the subject, "Prospects for the Consumption of Farm Products."

The Pittsburgh Chapter.—Luncheon meetings have been held at the Harvard-Yale-Princeton Club, Pittsburgh, on July 27, August 24, and September 28. The subject of the first was "The National Recovery Program and its Probable Influence on Business." Papers were presented by E. C. Stone, W. R. Bingham, T. H. Gerken and J. D. Beatty. Mr. Stone, Assistant to the President of the Philadelphia Com-

pany and President of the Pittsburgh Chapter, discussed the fiscal phases of the efforts being made to bring about recovery, concluding that sustained recovery cannot be produced for the last of 1933 and the first of 1934. Mr. Bingham of the Bell Telephone Company in his discussion of the Agricultural Adjustment Administration anticipated that materially augmented farmer buying power will help considerably toward recovery. Mr. Gerken of *Iron Age* presented the theoretical advantage of extensive reëmployment, yet felt industrial inertia would so slow down recovery as to force further inflationary steps. Mr. Beatty of the Carnegie Institute of Technology from labor and consumer standpoints described the retardation of public works programs and foresaw another critical winter of unemployment with much labor difficulty and extreme need for public relief.

On August 24, Mr. C. B. Metzger, Superintendent of the Edward A. Woods Company, spoke on "Three Years of Performance." He explained that as a distributor and conservator of wealth the life insurance institution has performed a stupendous function with the result that life insurance has come to be regarded as a property investment and savings available as security for any emergency requiring cash. Life insurance companies have rendered many services over the past three years. They have increased employment; they have been an aid to city and country banks; and they have disbursed money through policy loans and cash surrender values.

The meeting on September 28 was addressed by Mr. L. Brandt, a Housing Engineer of Pittsburgh, who spoke on "Plan for the Development of Garden Homes Under Subsistence Homestead Division, U. S. Department of the Interior, as Provided for in the National Recovery Act." He discussed the movement in theory, showed the steps that have already been taken, and forecast some of the probable results.

United States Bureau of Labor Statistics.—For several months the Bureau has been devoting a great deal of its time to preparing material needed by the National Recovery Administration. In this connection, a field survey of labor in the shirt industry was conducted jointly, in June, 1933, by the Bureau of Labor Statistics, the Children's Bureau, the Women's Bureau, and the Conciliation Service of the United States Department of Labor. The study covered approximately 20,000 workers in 129 establishments in 9 of the principal shirt-manufacturing states. The results of the inquiry were published in the *Monthly Labor Review* for September, 1933.

An investigation of the cost of living of government employees in the District of Columbia was begun in September by the Bureau of Labor Statistics in coöperation with the Bureau of Home Economics of the United States Department of Agriculture. The investigation is being made for the purpose of securing data to be used in the adjustment of the wages of Federal employees.

The Bureau will report monthly, in the *Labor Review*, statistics of employment created as a result of expenditures by the Public Works Administration, showing the total number of workers employed, the man-hours worked, and the amount of pay rolls. In addition, the tabulations will show expenditures for materials purchased and the amount of employment created indirectly in the fabrication of these materials. The first report will present data for the period September 15 to October 15, 1933.

The labor provisions of the industrial codes adopted under the National Industrial Recovery Act are being summarized by the Bureau and published in the *Labor Review*.

Surveys of wages and hours of labor are being conducted for air transportation and for motor-bus and truck transportation. During recent months there have been published in the *Labor Review* data from the Bureau's latest studies of wages and

hours in bituminous coal mining, in the iron and steel industry, and in the glass industry, and of union scales of wages and hours of labor and entrance wage rates of common labor.

In August the Bureau began collecting figures on retail prices biweekly instead of monthly as heretofore. Press releases summarizing the data are issued as soon as the figures can be tabulated, while full details are published in printed pamphlets. The Bureau also issues weekly and monthly wholesale price indexes.

Because of the great public interest in provisions for the care of the aged, information on the experience under state old-age pension laws has been gathered by the Bureau for several years. The experience for 1932 was covered in the August, 1933, *Labor Review*. An article in the October *Review* summarizes the recent state legislation on old-age pensions and compares the provisions of all existing state laws on this subject.

Other topics which have been the subject of special study by the Bureau, and of articles in the *Labor Review*, during recent months have included the accident experience in the iron and steel industry to the end of 1932; building operations during the first half of 1933; the credit-union movement in the United States in 1932; development of the coöperative movement throughout the world; and work of state labor offices in behalf of wage claimants.

Appointments to the Bureau of Foreign and Domestic Commerce.—On August 1, Dr. Willard L. Thorp of Amherst, Massachusetts, was appointed by the President as Director of the Bureau of Foreign and Domestic Commerce. He obtained his A.B. degree in 1920 from Amherst College, his M.A. degree from the University of Michigan in 1921, and his Ph.D. from Columbia University in 1924. In 1921 he was employed by the Census Bureau in the preparation of a special monograph entitled *The Integration of Industrial Operation;* from 1925 to 1926 he was Director of Research for the New York Board of Housing. He has been Professor of Economics at Amherst since 1926. He is the author of *Business Annals* and *Economic Institutions;* as well as a frequent contributor to magazines on various economic subjects.

Announcement has also been made of the appointment of Nathanael H. Engle, a former employee of the Census Bureau, to the position of Assistant Director of the Bureau of Foreign and Domestic Commerce. Mr. Engle served as expert in marketing with the wholesale census of distribution from April, 1930, to December, 1932. He has been on the staff of Brookings Institution since last December. Mr. Engle is a graduate of the University of Washington and holds the Ph.D. from the University of Michigan. He is author of a score or more of articles and monographs on business and economic subjects, including several bulletins prepared as a part of the Fifteenth Census.

United States Department of Agriculture.—Funds for the maintenance of the market news service of the Bureau, which had been entirely cut off and then partially restored, were on August 17 still further increased by order of the Secretary of Agriculture. The reduction in market news funds now stands at about 25 per cent.

Dr. Frederick V. Waugh, formerly Executive Secretary of the New England Research Council, on July 1 joined the staff of the Division of Statistical and Historical Research. In coöperation with the Consumers Council of the Agricultural Adjustment Administration, he is engaged in research to determine the relation between consumption and the prices consumers have to pay, and the factors affecting the consumption of agricultural products.

Reduced appropriations have necessitated certain curtailments in the Foreign Agri-

cultural Service of the Department of Agriculture. The offices at Pretoria, South Africa, and Sydney, Australia, have been closed and the officers in charge of these posts have been recalled to the United States. From each of the posts at Belgrade, Yugoslavia; Marseilles, France; and Buenos Aires, Argentina, where formerly two representatives of the Department have been stationed, one officer has been recalled. Clerical and operating expenses in the Berlin, London and Shanghai offices have been reduced. The vacancy in the former position of commodity specialist on tobacco in Europe has not been filled, but the commodity specialist in China on cotton and the commodity specialists in Europe on fruits, on grain, and on meats and wool continue to function as formerly.

In response to Senate Resolutions 280 and 281 respectively, there have been prepared in the Bureau of Agricultural Economics reports issued as Senate Document No. 70, "World Trade Barriers in Relation to American Agriculture," and Senate Document No. 184, "Economic Situation of Hog Producers." The former pertains to restrictions upon international trade in major agricultural products throughout the world, measures undertaken in several countries to protect the position of their farm producers, and the effects of these restrictions and measures upon prices of farm products and the welfare of American farmers. The latter pertains to the hog situation and the probable effects of the proposed export debenture, equalization fee, and domestic allotment plans for farm relief, on the economic position of hog producers.

A booklet by L. H. Bean and A. P. Chew, entitled "Economic Trends Affecting Agriculture," consists of statistical charts and tables, accompanied by brief explanatory notes. The contents of the booklet (which is intended primarily for agricultural extension workers) are grouped under three main headings: "The Relation of the Industrial Depression to Agriculture," "World Influences on American Agriculture," and "Disparities in Incomes and Prices." The introduction to the booklet says: "Farmers could get along formerly with comparatively few economic facts . . . Things are different now . . . Economic information useful to farmers no longer means information relating exclusively or even mainly to farming. It touches practically every phase of our complex and highly integrated economic system."

Market Reviews and Statistical Summaries of Livestock, Meats and Wool is the name of a new publication issued weekly by the Bureau of Agricultural Economics. Compiled and edited by the Livestock, Meats and Wool Division, it is designed to carry in convenient form the more important economic statistics pertaining to the livestock, meats, and wool industries as they become available. Current weekly, monthly, and yearly livestock price and supply data will be carried, as well as brief interpretative articles and special discussions dealing with economic conditions and developments in these industries.

Children's Bureau, United States Department of Labor.—The *Monthly Bulletin on Social Statistics*, now being published by the Children's Bureau, combines in a single publication the current reports on relief and other welfare services formerly presented separately in the *Monthly Relief Bulletin* (issued since January, 1932) and the *News Bulletin on Social Statistics in Child Welfare and Related Fields* (issued since July, 1932). The current statistics on relief are reported to the Children's Bureau by approximately 1,000 agencies in 120 cities and city areas and show expenditures from public and private funds and the number of families aided. Separate reports on meals and lodgings provided to homeless and transient persons are reported monthly by 186 agencies in 58 cities. The social statistics project covers 21 subjects in child welfare and related fields and includes a total of approximately 2,200 agencies in 43 of these cities.

The relief and social statistics constitute one of three major series of statistics now assembled and reported regularly by the Children's Bureau, the other two being juvenile employment statistics, based upon reports from officials in an increasing number of states and cities, in charge of issuance of employment certificates to working children, and juvenile court statistics relating to juvenile delinquency, dependency and neglect.

The Children's Bureau first began in 1921 systematically to collect and analyze statistics of employment certificates issued to children going to work, and the number of certificating officers reporting is now large enough to indicate the trend in the numbers of children leaving school to go to work, and the extent of their gainful employment for intercensal years. Statistics for 1932 are now being tabulated and will be summarized in the forthcoming annual report of the Chief of the Children's Bureau.

Statistics on juvenile delinquency, dependency, and neglect for the year 1932 will appear shortly in the report on Juvenile Court Statistics which has been published annually by the Children's Bureau since 1927. Increasing numbers of juvenile courts are now coöperating in the Bureau's plan for uniform reporting of these statistics.

In the health field, two important studies in which much statistical work was involved, the reports of which will soon appear in print, are the study of maternal mortality, covering about 7,500 maternal deaths in 15 states, and a study of the effect of tropical sunlight on the development of bones of children in Puerto Rico. The latter is one of a series of rickets studies made by the Bureau over a period of years.

Coöperating with three other bureaus of the Department of Labor, the Children's Bureau recently assisted in a survey of the shirt industry in nine of the principal shirt-manufacturing states. The study involved an investigation of about 20,000 payroll records in 129 plants and, where available, a study of the hours worked. The Children's Bureau had charge of the statistical tabulations of the findings and of the writing of the report, which was made public by the Secretary of Labor.

Women's Bureau, United States Department of Labor.—A summary of labor legislation for women enacted between January 1 and June 30, 1933, has been published by the Women's Bureau. In at least 14 states new labor laws for women or amendments to old laws were passed during this period. Outstanding were those passed in seven states providing for the fixing of minimum wage rates for women and minors. Hour laws were amended or revised in eight states.

From information obtained from statements of two engineers, one research organization, one textile labor leader, and one cotton-mill owner, together with other facts, the Women's Bureau issued a "Memorandum on the Practicability of Setting Maximum Standards of Work in Cotton Mills Operating Under the Stretch-Out System." This study followed the raising of this question by the South Carolina State Legislature.

A survey covering the hours, earnings, and employment of workers in the cotton mills of Maine, South Carolina, and Texas in 1932 was made by the Women's Bureau in an effort to learn something of the effects of the depression in this second largest woman-employing industry. About two-thirds of all the women reported employed in cotton manufacturing in these states were included in the study.

Of these three states full-time women workers on the day shift in Maine showed the highest median of a week's earnings—$13; in Texas the median was $11.10; and in South Carolina it was $9.65.

All but one mill of the 128 reporting in South Carolina and 11 of the 13 in Texas were on a 10-hour day. In Maine 10 of the 14 mills worked a day of 9¾ hours. The operating of mills at night was far more extensive in South Carolina than in either

Maine or Texas. In the mills where women worked at night, the hours were shorter in Texas than in South Carolina. No women were reported on the night shifts at the time the study was made in Maine.

The numbers of workers in the mills of South Carolina and Texas had a higher average in the last four months of 1931 than for the year as a whole; but in Maine employment decreased somewhat in the last third of the year. Increased employment in South Carolina and Texas was largely due to increased night shift operating. Though the exact amounts of short time during the year are not known, it is evident that a considerable number of mills that operated at night in one or more departments several months of the year also curtailed employment on the day force to a considerable extent. In all three states the most frequent reason given in the mills where there was short time or reduced employment was the decreased demand for goods.

A second part of the cotton study is a survey of 14 mills in Pennsylvania manufacturing narrow cotton fabrics—tapes, bindings, braids, etc., five mills in Massachusetts and Rhode Island; and three in North and South Carolina. While a branch of the cotton industry the processes on which women are engaged in these mills were not like those in the wide goods mills and no comparison between the two can be made. The proportion of women is almost twice as high in the mills in Pennsylvania as in those in the southern states represented. Full time earnings were highest in Pennsylvania, with a median of $13.85 and lowest in the southern mills, with a median of $9.55. For New England the median was $12.40 and for all sections combined it was $12.85.

Now in press is a report on "Employment Fluctuations and Unemployment of Women." Material has been analyzed from several types of sources: The sections of the report dealing with employment fluctuations present analyses of such fluctuations in a number of important woman-employing industries, compiling data from the regular reports on these industries collected monthly by sex in three states, from several special studies also showing employment fluctuation, and from similar data for woman-employing industries in three other important industrial states that do not collect figures by sex. Reports on unemployment issued by the United States Bureau of the Census and 21 special studies on the unemployment of women made by the Women's Bureau and various other authorities, form the basis of the material shown in regard to the unemployment of women. The final section of the study cites information furnished by official reports printed or mimeographed in 22 states and giving data by sex as to activities of state-supported employment agencies. These data have been brought together to show something of what the entire picture may be.

Fellows of the Econometric Society.—The Econometric Society, an international body for advancement of economic theory in its relation to statistics and mathematics, was organized two years ago, and with a membership of economists from almost all important countries, its aims especially are to study the causes and cures of depressions. It held sessions in Chicago recently in conjunction with the American Association for Advancement of Science. Its journal is edited by Professor Ragnar Frisch of Norway, who was a visiting professor at Yale three years ago.

The present officers are Professor Fisher, President; Professor Divisia, Vice-President; Dr. Roos, Secretary; and Alfred Cowles, 3rd, Treasurer.

The Society has elected the following Fellows: Professors Luigi Amoroso of the University of Rome, Italy; Oskar N. Anderson of Varna, Bulgaria; A. L. Bowley of the London School of Economics, England; Clement Colson of l'Ecole National des Ponts et Chaussées, Paris; Gustavo Del Vecchio of University of Bologna, Italy; François Divisia of l'Ecole Polytechnique, Paris; Griffith C. Evans of Rice Institute, Houston,

Texas; Irving Fisher, Yale University; Ragnar Frisch of University of Oslo, Norway; Corrado Gini of the Instituto Centrale di Statistica del Regno d'Italia, Rome; Gottfried Haberler of Vienna; Harold Hotelling of Columbia University; John M. Keynes of King's College, Cambridge, England; Wesley C. Mitchell and H. L. Moore of Columbia University; Umberto Ricci of University of Giza, Egypt; Henry Schultz of University of Chicago; Felice Vinci of University of Bologna, Italy; E. B. Wilson of Harvard University; Dr. Albert Aupetit of Paris, formerly secretary of the Bank of France; Dr. N. D. Kondratieff of Moscow; Dr. Charles F. Roos, formerly secretary of the American Association for Advancement of Sciences, now with the National Recovery Administration; M. Jacques Rueff, attaché financier, Ambassade de France, London; Dr. Erich Schneider of Dortmund, Germany; Dr. J. Tinbergen of Scheveningen, Holland; Vice Minister of Finances, W. Zawadsky of Warsaw, Poland; Dr. F. Zeuthen of University of Copenhagen; Professor Boninsegni of University of Lausanne, Switzerland; Professor Joseph Schumpeter of Harvard University.

A Study of Health and the Depression.—A four-phase study of the health of the wage-earning population during the depression is being conducted by the United States Public Health Service and the Milbank Memorial Fund. The study embraces (a) sickness in 1933 and mortality experience, employment, occupation, and income in the period 1929–1932; (b) nutrition of children, and (c) diet and other living conditions in the families surveyed; (d) mortality of the general population in areas that can be classified according to economic status, severity of unemployment, amount of social relief, and other conditions.

The collection of field data has been completed and the results are now being tabulated and analyzed. About 12,000 families were included in the study. These families were selected from among the lower income classes in Cleveland, Pittsburgh, Morgantown and vicinity, West Virginia, Syracuse, New York City, Brooklyn, Baltimore, Greenville and vicinity, South Carolina, and Birmingham. The studies are under the direction of Mr. Edgar Sydenstricker, Director of Research of the Milbank Memorial Fund, and Dr. Selwyn D. Collins and Mr. George St. J. Perrott of the United States Public Health Service.

This study is being conducted also in coöperation with studies being carried on in several other countries under the offices of the Health Organization of the League of Nations. The American statistical committee on these studies is composed of Mr. Edgar Sydenstricker, Professor Walter F. Willcox, Dr. Louis I. Dublin, and Dr. Selwyn D. Collins.

The Brookings Institution:—The following additional fellowships have been granted for the year 1933–34: Anita Wells, University of Kentucky; Genpachiro Konno, Tokyo Imperial University; and Malcolm L. Merriam, formerly with the Bank of America.

The following persons have accepted temporary appointment to the staff of the Institute of Economics of the Brookings Institution for work in connection with the special studies now being undertaken: Aaron V. Abramson, John D. Black, Virginius F. Coe, Joseph S. Davis, Hans W. Dreyhausen, D. A. FitzGerald, Virgil Gilman, Paul T. Homan, Sherman Johnson, Edwin A. Lamke, Fred Lininger, Leon C. Marshall, Henry I. Richards, Harold B. Rowe, George W. Terborgh, Cyril B. Upham, and Max von Zabern.

Personals

The outstanding event of the statistical year has been the retirement of Professor Karl Pearson (see page 395) from the Galton Professorship at University College in the

University of London and the appointment of Dr. R. A. Fisher, for the last fourteen years Chief Statistician at Rothamsted Experimental Station, to the Chair of Eugenics in his stead. Professor Pearson's tenure of the chair has been marked by an enormous advance in the science of statistics, which largely owed its inception to his untiring energy and stimulating influence. Professor Fisher's work in the statistical field is too well known to need comment here. It is perhaps less widely realized that he has made valuable contributions to the science of genetics, as witness his theory of the evolution of dominance, and *The Genetical Theory of Natural Selection*, quite apart from his development of the theory and practice of genetical statistics.

Dr. Egon S. Pearson has been appointed to a readership in statistics at University College, University of London.

Felix Bernstein, Director of the Institute of Mathematical Statistics at Goettingen until ousted by the Nazi government, is this year engaging in research at Columbia University as visiting professor. He expects to carry on a statistical study of the relation between eye strain and old age, and also to advance the mechanical solution of partial differential equations.

Dr. Samuel S. Wilks, who as National Research Fellow at Columbia University and in England has published contributions to statistical theory, has been appointed instructor in mathematics at Princeton University.

Dr. H. Steinhaus, who was dozent in statistics and actuarial mathematics at Goettingen until the Nazi upheaval, is now in the employ of the Equitable Life Assurance Company in New York.

In May, 1933, by unanimous vote of the Council, Horace Secrist, of Northwestern University, was elected a corresponding member of the Manchester Statistical Society which was established in 1833. According to the rules of the Society, "Gentlemen distinguished for their ability and zeal in cultivating Statistical inquiries, and living at least 20 miles distant from Manchester, may be admitted as corresponding members."

Dr. Thomas Park, National Research Council Fellow in Zoölogy, is spending the present academic year in the Department of Biology of the School of Hygiene and Public Health of The Johns Hopkins University, continuing his experimental studies of population problems in the flour weevil, *Tribolium confusum*.

Miss Ruth DeWitt Pearl, assistant in the Department of Biology of the School of Hygiene and Public Health of The Johns Hopkins University, is on leave of absence for the current academic year, working in the Zoölogisches Institut at Munich, Germany.

Mr. G. M. Whitright, formerly engaged in economic and statistical work for the American Telephone and Telegraph Company and Cities Service Company, was recently employed by the United States Senate Committee on Banking and Currency on Mr. Ferdinand Pecora's New York staff which was inquiring into the practices of private bankers and into the practices of the New York Stock Exchange. At present, he is employed by the National Association of Manufacturers and is engaged primarily in labor studies.

Obituary

Edwin W. Kopf, late Assistant Statistician of the Metropolitan Life Insurance Company, born in Newark, New Jersey, on November 3, 1888, died on August 3, 1933,

at Chatham, New Jersey. Mr. Kopf had taken an active part in the affairs of the American Statistical Association. Of his extended services to a number of committees of the Association should be especially mentioned his energetic work as Chairman of the Membership Committee from 1922 to 1928; and as member of the Committee on Educational, Scientific and Professional Standards from 1924 to 1925. To the JOURNAL he contributed numerous articles and a very large number of book reviews. Among those closely associated with him he was known for his encyclopedic knowledge of insurance and particularly of insurance history and for a keenly critical mind. He entered the insurance field at an early age, in the employ of the Prudential Insurance Company of America; in 1912 he accepted a call to become chief clerk of the newly organized Statistical Bureau of the Metropolitan Life Insurance Company. Here he was largely responsible for the training of the personnel. He established high standards of workmanship and inspired many a young clerk to develop real interest and skill in the field of statistical analysis. He took an active part and a lively interest in the conduct of the *Statistical Bulletin* published monthly by the Metropolitan Life Insurance Company.

Mr. Kopf served many scientific societies both as member and as officer. He was particularly active in the establishment of the Casualty Actuarial Society of America, and for a number of years served as Member of the Council and as Chairman of the Educational Committee. He served on numerous committees for the American Public Health Association, The National Research Council, The National Safety Council, etc.

He maintained many active contacts with leaders in the field of insurance both in this country and in Europe, gaining and maintaining an international reputation for his statistical scholarship, more particularly in the field of insurance and vital statistics. Through a series of courses which he gave at Columbia University, the younger students of insurance had an opportunity of benefiting from his extensive knowledge in this field. He contributed to several cyclopedic works, among them the *American Dictionary of Biography*, for which he covered the biographies of notable persons in insurance. He also covered the same field for the *Encyclopedia of the Social Sciences*.

Mr. Kopf died a relatively young man, but with a noteworthy career behind him. In his death, insurance scholarship has lost one of its dominating figures.

ALFRED J. LOTKA

ADDITIONAL COMMITTEE APPOINTMENTS

Representative on the Council of the American Association for the Advancement of Science
William F. Ogburn

Advisory Committee to the Secretary of Labor
Ewan Clague

Committee on Calendar Reform
Meredith M. Stiles

MEMBERS ADDED SINCE SEPTEMBER, 1933

Baehne, G. W., Research, International Business Machines Corporation, 270 Broadway, New York City

Bowden, Dr. Witt, Bureau of Labor Statistics, U. S. Department of Labor, Washington, D. C.

Davis, Reverend Joseph L., S.J., Regent, School of Commerce and Finance, St. Louis University, 3674 Lindell Boulevard, St. Louis, Missouri

Easter, J. Blair, Secretary-Treasurer, John A. Beattie and Company, Benedum-Trees Building, 11th Floor, Pittsburgh, Pennsylvania

Fedak, Stephen A., 3225–93rd Street, Jackson Heights, Long Island, New York

Fosbury, Francis J., Acting Treasurer, Co-operative Cheese Plant, Pike, New York

Grogan, Starke M., Chief Statistician, Financial Statistics of States and Cities, Bureau of the Census, Department of Commerce, Washington, D. C.

Hale, Samuel E., Investment Counsellor, 60 Wall Street Tower, New York City

Hoag, W. Gifford, Bureau of Statistics, State Department of Agriculture and Markets, Albany, New York

Johnson, Dr. Palmer O., College of Education, University of Minnesota, Minneapolis, Minnesota

Kraus, Walter, Statistical Research, New York State Commission for the Blind, 80 Centre Street, Room 634, New York City

Lang, Richard O., Research Assistant, Social Science Research Committee, University of Chicago, Chicago, Illinois

Martin, Robert F., Division of Economic Research, U. S. Bureau of Foreign and Domestic Commerce, Washington, D. C.

Mauk, Mrs. Helen S., 106 East 17th Street, New York City

Mead, Marion, Director and Librarian, Research Department, Illinois Chamber of Commerce, 20 North Wacker Drive, Chicago, Illinois

Mitchell, Walter, Jr., Market Analysis, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, Department of Commerce Building, Room 3087, Washington, D. C.

Moussa, Mohammed F., Egyptian Ministry of Finance, Cairo, Egypt

Odate, Yoshio, Actuary, Nippon Life Assurance Company, 7 Imabashi Shichome, Osaka, Japan

Onody, George R., Stock brokerage, 52 Broadway, Room 900, New York City

Ore, Dr. Oystein, Yale University, New Haven, Connecticut

Parten, Dr. Mildred, Sociological Research, Yale Institute of Human Relations, New Haven, Connecticut

Pettet, Zellmer R., Chief Statistician, Division of Agriculture, Bureau of the Census, Department of Commerce, Washington, D. C.

Riley, Donald C., Statistician and Municipal Analyst, W. G. Riley and Company, One Wall Street, New York City

Smith, Professor E. Dillon, Department of Industrial Engineering, Columbia University, New York City

Stiles, Meredith N., Calendar Reform Research, Eastman Kodak Company, 343 State Street, Rochester, New York

Thompson, Dr. William R., Research in Pathology, School of Medicine, Yale University, New Haven, Connecticut

Tolg, Clarence, Production Manager, Munsingwear Corporation, 718 Glenwood Avenue, Minneapolis, Minnesota

Waldron, William M., Research, Jaeger Watch Company, Inc., 304 East 45th Street, New York City

Yang, Simon, Statistician, Institute of Social Research, 3 Wen Tsin Chieh, Peiping, China

REVIEWS

Pitfalls in the Statistical Construction of Demand and Supply Curves, by Ragnar Frisch. Frankfort: Frankfurter Gesellschaft für Konjunkturforschung. 1933. 39 pp.

Professor Frisch has set forth a simple, if over elaborate, mathematical exposition of the cases in which neo-classical demand and supply curves may or may not be derived from statistical price-quantity distributions. His discussion centers around the method developed by Dr. Wassily Leontief,[1] in which both the demand and the supply curve are derived simultaneously from the price-quantity data. Although certain of Frisch's criticisms of Leontief are justified, Leontief is made the target of a number of undeserved criticisms.

The first five sections state nothing new. They are rather a recapitulation, in mathematical terms, of the theory, well known to specialists in this field, that if the demand curve remains stable and the supply curve shifts, or vice versa, either the demand curve or the supply curve can be determined from the price-quantity data.[2] If both of them shift, then any observed correlation in the scatter diagram may be due to a correlation between the trends of the price and quantity series. If the shifts are uncorrelated, then there is no known method of deriving the demand and supply schedules, except by some such assumptions as Leontief's. Frisch states the problem in terms of two sets of time series: the series of prices and quantities, and the series of their respective shifts. It is then shown that the case to which any particular price-quantity distribution belongs is fundamentally determined by r, the correlation coefficient of the price-quantity distribution, ρ, the coefficient of correlation of the shift distribution, l, a measure of the relative violence of the price and quantity series, and λ, the relative violence of their shifts. Starting out with two linear equations for the demand and supply curves, in which α and β are the demand and supply elasticities, u and v their shifts, Frisch develops mathematical criteria for each case, and derives the elasticities. For example, when the demand curve remains constant, $\lambda=0$, $\alpha=l(r\pm\sqrt{(1-r^2)})$, and β is indeterminate.

Economists, who have had some statistical training, would find even this simple mathematical treatment more intelligible, if it were made clear at the outset that l and λ are nothing other than the ratio of the two standard deviations, or $\frac{\sigma x}{\sigma p}$; and $\frac{\sigma u}{\sigma v}$. Therefore, α, in the case stated above, becomes the ordinary regression

[1] "Ein Versuch zur statistischen Analyse von Angebot und Nachfrage." *Weltwirtschaftliches Archiv*, July, 1929.

[2] See E. J. Working, *Quarterly Journal of Economics*, February, 1927; W. Leontief, *op. cit.*; W. F. Ferger, *Quarterly Journal of Economics*, November, 1932, and others.

coefficient, if r is equal, or nearly equal to l. In any case in which $\lambda = 0$ or ∞, the elasticity to be derived is equal to the regression coefficient. This is stated by Frisch, but on the whole little attempt has been made to relate his terminology to the nomenclature of economic statistics.

The above analysis which extends over some 20 pages of Frisch's pamphlet has been very clearly and briefly stated in non-mathematical terms by Leontief himself.[1] Incidentally, his statement of the theory is quite independent of the similar analysis by E. J. Working, to which Frisch refers. Leontief very definitely restricts the application of his method to the cases in which both the demand and supply curves shift. Consequently, Frisch's statement that "if Leontief's method shall have any raison d'être, it must be through its application to the non-stability cases"[2] is in complete agreement with Leontief's own treatment.

In the analysis of the assumptions which must be made as to the nature of the two parts, into which the whole price-quantity distribution must be divided in Leontief's method, Frisch has made a real contribution. The arbitrary division of the data into two parts, with the assumption that the same elasticity exists in both, has always seemed questionable. Frisch proves mathematically that in order to derive elasticities which have any meaning, not only must the shifts be uncorrelated, but the ratio of the standard deviations of x and p, or l, and the coefficient of correlation, r, must differ significantly in the two parts. Leontief did not discuss specifically the nature of the two divisions of the price-quantity distributions which lie at the basis of his method although he stated that they should be as different as possible.[3] It may be pointed out that Frisch has thereby not invalidated Leontief's method, but has made more precise the statistical and economic considerations upon which it must be based. Frisch's third criterion for the case in which Leontief's method may be applied is the same as Leontief's, namely, uncorrelated shifts of the two schedules.

When there are distinct trends in the price and quantity series, it is indicated by Frisch that Leontief's coefficients are, one of them, the slope of this trend relation, and the other, meaningless. Leontief is not quite clear on the question of the relation of trend to his method. He seems to think that trends are taken care of by his consideration of shifting, whereas Frisch states correctly that a strongly defined trend in the two original series is one of the most important cases in which the shifts are correlated.

It is surprising to find Frisch's statement to the effect that ". . . if there is no trend relation both Leontief's coefficients are meaningless. And if there does exist a trend relation, one of his coefficients gives just this trend relation while the other coefficient is meaningless."[4] Two pages previously he summed up the assumptions on which an application of Leontief's method can be based, one of

[1] *Op. cit.*, pp. 17–21.

[2] *Op. cit.*, p. 35.

[3] It should be said, however, that Dr. Robert Schmidt has developed a method for determining the reliability of Leontief's elasticity coefficients, based on a general consideration of the two sections. (*Weltwirtschaftliches Archiv*, 1930, "Die Prägnanz der Elastizitätskoeffizienten.") Frisch dismisses this method as of little importance. Dr. Leontief has developed a further method, yet unpublished, for taking into account the nature of the two divisions of the data.

[4] *Op. cit.*, p. 39.

which is the case of uncorrelated shifts or no trend relation. Frisch appears to be denying his earlier proof. Possibly the contradiction may be explained by some sort of typographical error, with which the book abounds. It is regrettable that so many mistakes in spelling should have been allowed to remain in the final form of the pamphlet.[1]

Frisch considers that the pitfalls in the derivation of demand and supply curves "have been very nearly completely overlooked in the statistical works of recent years." His attention should be called to a number of articles appearing in current journals, most of them non-mathematical, one of which is particularly à propos to his present discussion. A detailed application of Leontief's and Schultz' method to the same price-quantity data was carried out two years ago.[2] It was there shown that neither method could be applied indiscriminately to all price-quantity distributions, and the assumptions of Leontief's analysis were critically discussed. It is true that the limitations of the method were not there mathematically defined, but it can scarcely be said that the difficulties were "nearly completely overlooked."

It is good to find Frisch joining the select company of those who emphasize the necessity of using mathematics with extreme care in connection with economic data. His statement upon the subject is worth quoting:

> In this field we need, I believe, a new type of significance analysis, which is not based on mechanical application of standard errors computed according to some more or less plausible statistical mathematical formulae, but is based on a thoroughgoing comparative study of the various possible *types of assumptions regarding the economic-theoretical set up*, and of the consequences which these assumptions entail for the interpretation of the observational data.[3]

If mathematicians who have turned economists would hang this as a motto over their desks, the extension of mathematics into the general field of economics would be considerably accelerated. Unfortunately most of them are more occupied with the niceties of mathematical development than its significance in actual economic terms. It should be said here that Leontief paid considerable attention to the economic bases of his method, and ought not to be classified, as the reader is led to infer, with those who indulge in the blind use of statistical method.

There are a number of other "pitfalls" which might have engaged Frisch's attention. The problem of trend elimination, to mention only one of them, in an attempt to isolate what he calls the "Cournot effect" in the price-quantity distribution, is one of great importance. If trend is eliminated, are not at least part of the shifts of both the demand and supply schedules also eliminated? And how, then, can the criterion of "relative violence" of shifts be applied? It is also to be noted that the existence of trends in the time series of prices and quantities does not necessarily cause them to be correlated. The reviewer has re-

[1] For instance, p. 12, "prameters" for parameters; p. 15, "exkibits" for exhibits; p. 16. "may" for way; p. 18, "abtained" for obtained; p. 19, "trival" for trivial; etc. Also, accents are omitted whenever French phrases are used.

[2] E. W. Gilboy, "The Leontief and Schultz Methods of Deriving Demand Curves," *Quarterly Journal of Economics*, February, 1931.

[3] *Op. cit.*, p. 39. See also a very similar statement by F. Divisia, "Economique et Statistique," *Revue d'économie politique*, 1932, p. 1481.

cently dealt with series in which distinct trends were noticeable, but very little correlation was evidenced in the price-quantity distribution.

On the whole, it may be said that Frisch provides quite a useful mathematical statement of the relation between equilibrium theory and statistical data. He also develops definite mathematical criteria for the classification of price-quantity distributions as ones from which classical demand or supply curves may or may not be derived. Used in conjunction with all the economic material available, these criteria should prove useful to economists interested in this problem.

ELIZABETH WATERMAN GILBOY

Harvard University

Public Utility Regulation, by William E. Mosher and Finla G. Crawford. New York: Harper and Brothers. 1933. 612 pp.

Public utility industries and their regulation form a field of inquiry which has only recently come to be recognized as separate and independent. The sign and portent of this status is the appearance in college catalogues of courses on Public Utilities and their inseparable attendant, the college text book. *Public Utility Regulation* is not likely, I think, to be an altogether satisfactory text book. It is neither insipid enough nor platitudinous enough to measure up to the long established and well tested standards for this type of work. In fairness to the authors it should be said that the writing of a text book on the subject was probably not their main intention. A considerable knowledge of the elementary facts and problems of the field is taken for granted, and the authors are more interested in weighing the effectiveness of regulation than in expounding to the beginner the A B C of the subjects.

In this epoch of "crises" of various sorts the crisis in public utility regulation has established itself as one of the most authentic. Professors Mosher and Crawford are peculiarly well equipped to analyze the nature of this crisis. Both of them closely associated with the intensive New York public utility investigation of 1930, they are able to unite an intimate, practical knowledge of the subject with the requisite economic, legal, engineering, and accounting training. Although the book rather stresses the administrative aspects of regulation, it is not at the expense of the legal and economic. Indeed, in their handling of the tricky problems of valuation and rate structures, the authors reveal themselves as better economists than most.

The field of public utilities is a singularly amorphous one, and books on the subject, including this book, inevitably reflect this formlessness. It is a field from which good lawyers tend to emerge as half-baked economists and good economists as half-baked lawyers. The concept of public utility industries is not a clear-cut economic concept, and the economic problems of these industries give the appearance of being torn from their context by the exigencies of public policy. On the legal side we have the spectacle of the courts wrestling with new problems and concepts alien to our law only to emerge with decisions which

are neither good law nor good economics. It is a field created by and imbued with the spirit of the practical demands of public policy. In this field Professors Mosher and Crawford step with admirable care, and if their book, which is the best on the subject yet to appear, seems a little shapeless, it is not their fault but the fault of their material.

As a study of the problems and difficulties of administration, it is altogether admirable. The analysis of the personnel of state regulatory commissions and of the qualifications necessary for effective administration throws new light upon a heretofore neglected aspect of regulation. More attention is paid to the very difficult and important question of the proper division of power between regulatory authorities and management than in any previous general treatise on the subject. The relation of the commissions to the courts is treated briefly but succinctly. The authors are not only critical in their handling of commission administration but intelligently constructive in their suggestions for reform.

There is nothing new in the treatment of the more familiar aspects of public utility problems, valuation, and rate making. But the authors succeed in presenting clearly the issues in the valuation controversy and handle competently the economics of utility rate structures. The chapters on holding companies were written without benefit of a careful study of the new material collected by the Federal Trade Commission, but it is doubtful whether such a study would add much to the treatment of the subject. The authors, perhaps, err slightly in striving too hard for completeness. Most of the last section dealing with special problems such as grade-crossing elimination, rural electrification, and the like, could have been left out without damage to the book.

EDWARD S. MASON

Harvard University

The Triumph of Mediocrity in Business, by Horace Secrist. Chicago: Bureau of Business Research, Northwestern University. 1933. xxix, 468 pp.

Contrary to the Marxian doctrine that capitalism is unstable and bound to explode, the reader of this and the author's previous books on the subject gathers that a remarkable tendency to stability holds sway. Numerous graphs such as those on page 445, which show a distribution of department stores for each of six successive years with regard to ratios of expenses to sales, display lines which come together irregularly but unmistakably. Similar charts and numerical tables show convergence from year to year during the War and post-war period for a great variety of business ratios connected with department stores, retail clothing, retail hardware, and wholesale grocery stores, banks and railroads; also for the variables of agricultural economics, arrayed by states. The labor of compilation and of direct collection of data must have been gigantic.

The inference appears to be that extreme deviations from the average tend to disappear, while mediocrity triumphs. We read on page 38:

> Regression to type characterizes such series, it being the prevailing tendency of ratios which are relatively high to decrease, or to increase less than those which are low; and of those which are low to increase, or to fall less than those which are high.

And in the preface:

> The tendency to mediocrity in business is more than a statistical result. It is expressive of prevailing behavior relations.

This conclusion, if true in the sense in which the reader naturally interprets it, would be of immense importance. But unfortunately the codicil must be added, though it is not added in the text, that while the concerns at the margins of the group, if they remain in business, often go toward the center, those in the center of the group also go toward the margins. Some go up and some down; the average of the originally central group may, therefore, display little change, since the positive and negative deviations cancel in averaging; while for an extreme group, the only possible motion is toward the center.

The converging lines in the graphs are averages of groups, arrayed according to the value of the variable in the first year of the series. If the concerns were arrayed according to the values taken by the variable in the last year of the series, the lines would diverge. Thus from the same data one may demonstrate stability or instability according to taste. The seeming convergence is a statistical fallacy, resulting from the method of grouping. These diagrams really prove nothing more than that the ratios in question have a tendency to wander about. If one compares the stores or banks to a cluster of stars, one must not think of them as falling together in a resisting medium toward their common center of gravity, but merely observe that they move about within the cluster. If those remotest from the center are watched for a time, their average distance from the center will naturally decrease; but it does not at all follow that the cluster is contracting.

The real test of a tendency to convergence would be in showing a consistent diminution of variance, not among means of groups, but among individual enterprises. Diminishing variance among means of groups is entirely consistent with a stationary, or even an increasing variance of the whole. In certain of the tables are presented standard deviations and average deviations of the whole sample in successive years, though little attention is devoted to them. The strongest contributions to the thesis of convergence are the values of these measures of dispersion on pages 73 and 142, which decrease each year from 1920 to 1924 inclusive, and in some cases also in 1925. However, the changes in dispersion are so slight as conceivably to be attributable to sampling fluctuations. On the other hand, the table on page 166 of ratios of net profit or loss to net sales for 49 identical department stores gives the average deviation for each year from 1920 to 1930 inclusive; and these fluctuate most irregularly. Fitting a trend line to them would seem to show an upward rather than a downward tendency in the variance, though with great irregularities. The clothing store dispersions on page 193 for 1916–22 likewise show considerable fluctuation and an apparently rising, though doubtful, trend. There are a few other tables of average or standard deviations, which also fail to support the thesis of convergence.

The technique of following graphically the means of initially arrayed groups is defended by applying it to temperatures of cities, and noting that the groups

of cities which were hottest or coldest in the initial year remain respectively the hottest or coldest throughout. But this means merely that the cities do not move about, while business ratios do. To revert to the analogy of the star cluster, we should for this temperature study have to hold each star within a small fixed region. The argument that business ratios converge because the means of initially arrayed groups converge is definitely incorrect.

The thesis of this and of some preceding work by the author can be made true by interpreting it to mean merely that averages of groups chosen in this particular way converge. This conclusion is mathematically obvious from general considerations, and does not need the vast accumulation of data adduced to prove it. These volumes clearly represent immense labor in collecting data, computing, and drawing graphs. It is to be hoped that the material can be used for other purposes than to prove that business is stable, and will be treated by sound statistical methods.

HAROLD HOTELLING

Columbia University

Minor Papers on the Currency Question, 1809–1823, by David Ricardo. Edited with an Introduction and Notes by Jacob H. Hollander. Baltimore: The Johns Hopkins Press. 1932. ix, 231 pp.

Professor Hollander has rendered fresh service to the history of economic thought by editing and publishing Ricardo's Minor Papers on Currency. "The recovery and publication, in 1928, of the long missing and much-desired manuscript of David Ricardo's 'Notes on Malthus' was welcomed [Dr. Hollander points out] by close students of the Ricardian economics as filling gaps and as clearing doubts on the doctrinal differences of its chief figures. In conjunction with the 'Notes on Malthus,' a considerable body of additional Ricardo material, manuscript and printed . . . was brought to light. This matter is now made available through the continuing courtesy of Frank Ricardo . . . a great grandson of the economist." The material in question centers around the currency problem, and thus warrants the title of the present volume, though it is not exclusively devoted to monetary discussion. Some of the material, as the editor notes, is mere scraps or scanty marginal comment on other authors, some has been published in contemporary letters to newspapers, and some was apparently left in fairly complete form, titled and paged. Various as it is in value, the text of these "remains" taken as a whole, is a valuable supplement to the Ricardian contribution to the currency and monetary problems of the time and furnishes many a connecting link, heretofore missing, for the use of those who would reconstruct the intellectual history of British monetary economists and economics during the first quarter of the nineteenth century—that period when so many doctrines destined to play controlling parts in the history of capitalistic thought were in the making. It should be added that many a wise word bearing directly upon current monetary discussion may be culled from these fragments and commentaries, framed as they were in circumstances

strangely similar to some of those which must be met and analyzed today.

The reader of this volume will find the several items it contains of greater or smaller interest and concern, according to the direction which he has given to his own individual studies. Yet most such readers will, on the whole, find largest significance, probably, in the commentaries upon the Bullion Report, and in the letters published in the *Morning Chronicle*, and dealing with various topics of contemporary interest in the field of money and banking. To these the discriminating will add no doubt the Plan for a National Bank already well-known but now offered prefixed with a skeleton outline, and completed by a brief supplementary note. The comparisons of the views of Ricardo and Torrens on "The Measure of Value," and the correspondence between Ricardo and J. B. Say must likewise be included in any selection of choice bits that will please the taste of the general economic reader.

It is, of course, largely out of the question to read these fragments of Ricardian economics, without first having or refurbishing a fairly extensive and critical knowledge of the writing and point of view of the author, at least in those tracts of thought which are chiefly dwelt upon in these extracts. So equipped, however, the reader of the volume finds his memory and his critical historical sense sharply stimulated by the suggestive side-lights that are thrown by this collection not only upon Ricardo's own ways of thinking, but also upon the whole currency and banking controversy in which the work of the Bullion Committee was a central feature. As is now made clear, Ricardo, far from holding aloof from the practical discussions of the day surrounding the questions of immediate legislation, was a continuous and acute commentator upon them, and through correspondence, newspaper contribution, and critical analysis of the work of his contemporaries, did much to shape and direct the current of British thought into safe and well marked channels.

It may well be doubted whether these fragments will change in any large particular the general opinion of Ricardian doctrine on the topics dealt with. That was already clear, and had been too deeply appreciated through long-continued exegesis to be much altered by anything save the discovery of some major work whose existence or content had not before been imagined. As has been said, there is here nothing of the sort, but the data supplied will none the less serve as valuable additions in many directions to the stock of information available to Ricardian students. The essays and articles previously published are given greater value by the fact that they are now organized and arranged by a sympathetic hand in their proper logical and chronological relationships, so that their meaning may stand out definitely upon the background of the economic history of the period.

Economic thinking and economic and financial history are being steadily more closely linked by careful groupings of fugitive but essential materials like those contained in this collection. It is the new way of writing biography—from some points of view, the best.

H. Parker Willis

Columbia University

Direct Taxation in Austria, by John V. Van Sickle. Cambridge: Harvard University Press. 1931. ix, 232 pp.

This volume from the pen of the Assistant Director for the Social Sciences of the Rockefeller Foundation was awarded the David A. Wells Prize at Harvard University. The stated purpose is "to show how closely the public finances reflect the changing political fortunes of the various classes in the State and how vitally they affect the production and distribution of wealth" (p. vii). The period which is intensively analyzed is that immediately following the Great War, from the Armistice until the initiation of control by the League of Nations in 1922.

A background is first sketched in a chapter describing the direct tax system as it stood in 1914 and in a few pages devoted to developments during the war period. The post-war history is then introduced by an excellent brief description of the political and economic situation. Three substantial chapters, entitled, "The Direct Taxes in Republican Austria," "Concessions to Capitalistic Enterprise," and "The Capital Levy," contain the bulk of the results of the author's study and a final chapter summarizes his conclusions.

All will readily grant the extreme difficulty of the task which the author has attempted. Merely to describe accurately and clearly the tax system and its modifications is a technical task requiring much skill. But Dr. Van Sickle also essays the more delicate operation of tracing the responsibility for the changes made and their effects upon the various economic interests—and this, moreover, for a foreign country and during a period when extreme inflation was agitating the economic system. Finally he even aspires to appraise the record and to register a judgment, plentifully adorned with adjectives, as to the wisdom and foolishness of what was done. To undertake such a task requires courage and self-confidence of a high order and these Dr. Van Sickle certainly possesses. To carry it through with distinction requires qualities which no man can be expected to reveal, at least in his first book.

The manner in which the author disposes of highly doubtful and controversial questions reveals the "passion of youth for finalities" in an extreme form (see, *e.g.,* pp. 14, 16, 34, 47, 65–6, 73) and the emphatic judgments of the author would sometimes carry more conviction if he exhibited a higher degree of clarity or consistency in the norms he utilizes in assessing quality (*e.g.,* pp. 20–1, 39).

In his discussion of the capital levy, which is by all odds the best section of the book, Dr. Van Sickle reaches conclusions highly unfavorable to this device. The capital levy, in his view, is both inequitable and impracticable. It is inequitable, first, "because in an emergency all should contribute to the salvation of the country" (p. 176). The professional man on a large income is not effectively reached and, if he could be reached, it would be necessary for him to borrow in order to pay. Moreover, he contends, it is inequitable because different types of property will be assessed with different degrees of fullness and precision as American experience shows. The capital levy, he asserts, is impracticable, first, because of administrative difficulties—"Its high rates arouse

the resistance of all those liable to it" (p. 176); second, because its financial results have been disappointing wherever tried; and, third, because, since it is "seriously advocated only in countries which are in a desperate plight," it cannot expect efficient administration for if efficient administration were available, the country, forsooth, would never have gotten into a desperate plight!

With respect to all of this, the puzzled student of taxation may be permitted to interpose a few interrogation marks. Is the test of net assets alone less equitable than the test of net income alone and may it not be the part of wisdom and justice not to discard the test of net assets because it fails to reach those without accumulations? If American experience proves the impracticability of an appraisal of net assets (which, by the way, it probably does not) what is the significance of the experience of Germany with her *Vermögensteuer* and the experience of Switzerland with her *impôt sur la fortune?* Is it impossible to adjust the rates of a capital levy so that it will not "arouse the resistance of all those liable to it"; may not these rates vary greatly with the circumstances? Were not the circumstances hopelessly unfavorable in Austria? If, by chance, the levy should be "seriously advocated" and adopted in a country whose "desperate plight" is not caused by the breakdown of the administration of its direct taxes, can efficient administration of the levy be anticipated?

Similarly, the author's confident assertion (p. 190) that the "only policy capable of rescuing the country" was a long-time loan raises a series of queries regarding the validity of the assumptions involved. Again when he contends that "any attempt" to make direct taxes "the chief source of revenue in a period of depreciation . . . is bound to imprint upon them such a pronouncedly anticapitalistic character as to destroy any last vestiges of confidence of the possessing classes in the State . . . and to increase the tempo of depreciation" (p. 204) one wonders whether the author is not slightly intoxicated by strong language. Any attempt? Any degree of depreciation? Any last vestiges of confidence? Any possessing class? In any country? Under any circumstances?

The section dealing with the relations of state and local taxation is interesting and well done although it is difficult to understand why it is included under the general chapter heading of "Concessions to Capitalistic Enterprise."

Little care has been lavished on form. There are numerous instances of obscure statements susceptible of more than one interpretation. Unfortunately this lack of precision and clearness often occurs in statements of a statistical nature introduced for the very purpose of adding precision to vague adjectival phrases. Speaking of the 1916 increase in the income tax, which was accomplished "by the simple process of adding extraordinary surtaxes to the existing rates," the author says: "On incomes above this amount (3,000 crowns) the increases began with 15 per cent and rose to 120 per cent on the fraction above 200,000 crowns" (p. 47). To what these percentages applied is not stated. One may infer that they applied to the yield of the normal tax and not, as would at first appear, to the original income base, for "120 per cent on the fraction above 200,000 crowns" is rather high, even in war time! On the same page this statement appears: "More significant, however, were the

progressive additions on profits[2] above 6 per cent of capital and reserves." The footnote referring to "profits" reads: "The term 'profits' as used here meant the *ratio* (italics mine) of net profit, less corporation tax and interest on borrowed capital, to invested capital." Again it is stated (p. 51) that "The war profits tax on corporations was originally (1916) levied on *relative increases* of earnings." The rates (percentages) were not, of course, applied to a *ratio* or levied on *relative increases*. They were applied to profits in excess of a standard. At another point (p. 44) the author writes: "available fats and oils dropped from a tenth to a fifteenth of the pre-war quantity." Apparently what he meant was that they dropped to a level which was somewhere about a tenth or a fifteenth of the pre-war quantity. On page 88, speaking of the business tax, the author says: "There was little active discontent, however, because the slow increase of the contingent by 2.4 per cent every two years made the burden steadily lighter." Of course, it was not the slow increase of the contingent which made the burden steadily lighter. Other factors, such as the increased profitableness of business, more than offset the influence of the slow increase of the contingent. In several places the author speaks of "depreciation" in a fashion which makes it difficult to determine whether he refers to the monetary unit or to business assets (pp. 92, 150).

If he is sufficiently patient, the informed reader will be able in most cases to arrive at the meaning which the author intended to convey. However, the casual reader may sometimes be led astray and even the competent student will resent the unnecessary strain imposed upon him by the author's occasional lapses into loose writing.

In at least one case the fault is more serious than mere ambiguity or obscurity. On page 74 one reads: "Food subsidies were responsible for almost 30 per cent of the deficit—21,700 millions in a budget of just over 70,000 million crowns." Twenty-one million seven hundred thousand is indeed about 30 per cent of 70,000 millions but the 70,000 millions happens to be the total expenditures of the budget and not the deficit. The deficit, according to Dr. Van Sickle's figures on the preceding page but one, was 41,117.5 millions so the subsidies were responsible for not 30 per cent but nearly 50 per cent of the deficit.

Errors in typography and orthography are more frequent than is easily excusable. See, for example, "incidents" for incidence (p. 99); "affected" for effected (p. 133); "comsummation" (p. 64); "none . . . hold" (p. 183). On page 127, the reader is referred to a table on a page where no table appears. On page 34, line 19, "income tax" apparently should read "building tax" or *vice versa* in line 15.

The reviewer is not competent to pass upon the accuracy of the author's detailed description of the Austrian statutes. This task must probably be left to the Austrians themselves.

In spite of the blemishes of form and the irritating character of some of the pronouncements, the volume adds substantially to our knowledge of continental tax systems and is, on the whole, a promising and a stimulating piece of work. It is certainly the product of a vigorous and courageous mind. Students of taxation will look forward to Dr. Van Sickle's more mature contributions with

the hope that, in the fullness of years, caution and precision may be added to vigor and courage.

ROBERT MURRAY HAIG

Columbia University

Agricultural Systems of Middle Europe: A Symposium, by O. S. Morgan, Editor. Foreword by Honorable Arthur M. Hyde. New York: The Macmillan Company. 1933. xix, 405 pp.

This is a very important book for those who want a condensed, factual statement of the economic and social significance of agriculture in the eight countries of Middle Europe. These countries are Austria, Bulgaria, Czechoslovakia, Greece, Hungary, Poland, Rumania, Yugoslavia. Each country is described by a qualified expert residing in that country, usually a professor of agricultural economics or a person of high position in the Ministry of Agriculture.

To make these eight stories fit into a somewhat uniform pattern, the editor of the symposium furnished to each author an outline covering these heads: physical factors; population; land utilization; agriculture in the post war years 1918–1931; land reform; production, marketing; coöperation; taxation, insurance, and credit; education; agrarian politics; farm income; future outlook for farmer; problems of Pan-Europa. The book is more than a mere inventory of facts, although the editor has evidently intended it to be a book of reference rather than a volume of popular readings. Facts are selected, organized and presented so that broader principles of economics and politics emerge.

For example, the student of agricultural education can piece together a fairly full picture of this type of education in these eight countries. So also can the student of coöperative marketing, of farm credit, of state aid, of wheat marketing, and so on, do with his particular subject. Space is lacking to quote at length, but many passages are worthy of quoting in full. Only a few of the topics can be even mentioned in this brief review.

The strip system of farming in vogue in many parts of Europe has always been a source of critical comment to American observers. This subject is fully treated in this book. In Bulgaria, says the author,

> The land of the typical individual farm holding is not in one piece nor in a few compact pieces of land, but is in many small and scattered fields. The number of fields used for the various crops in their respective farm area classes ranges from 2.6 fields in the smallest farm size class (2 to 5 acres) up to 29.4 separate fields in the 75–250 acre group.

The expropriation of estates, following the War, was a drastic step to elevate the status of the peasant. In some cases production was decreased thereby. The authors report some favorable results in Rumania, Yugoslavia, Czechoslovakia, Greece and Poland. The author for Bulgaria (Professor Dr. J. S. Molloff) is not so sure: he says:

> The Land Reform has exercised and will continue to exercise a powerful influence upon many classes of population, both producers and consumers. Such an important social shift cannot be imagined, and it did not occur here, without

> an avalanche of dissatisfaction and real or imaginary grievances and injustices. The readjustment of the relative proportion of the various farm categories either strengthens or weakens entire classes of population, and also affects the productive capacity and social equilibrium of the country. It can not be summed up. It is entirely too complicated to find the exact principles and leading ideas that would give even a superficial insight into the work that has been accomplished and especially the longtime influence of the reform.

In all eight of these countries the expropriated estates were paid for. However, in Bulgaria, under the 1921 law, a supplemental graduated so-called "capital levy" was made on the large estates, taking from 15 to 20 per cent of them without compensation.

The number of agricultural workers per 100 acres of cultivated land is given for 24 countries, including these (note the low proportion for Great Britain):

Yugoslavia	16.5
Bulgaria	23.7
Rumania	16.6
Poland	17.5
Austria	9.1
Hungary	11.5
Czechoslovakia	11.5
Great Britain	3.1

The valorization of currants in Greece, the abolition of feudal servitudes in Poland, the ancient and wasteful strip system of land tenure, the relation of transport to progress (internationalization of the Danube), the delectable plum marmalade of Yugoslavia—these are samples of the topics which even the laymen find interesting.

A "planned" agriculture and a "rationalization of production" come in for much attention. Take wheat, for an example. In July, 1930, the first Danube Conference was held at Bucharest, three countries participating; the second conference was held in Yugoslavia in August, 1930; the third was held at Warsaw in August, 1930, eight countries participating. Then the League of Nations General Assembly took up the question of wheat in September, 1930. The fourth conference was held at Bucharest in October, 1930. Then the scope of these conferences widened into "Agrarian Conferences," continued at Sofia in December, 1931. A Wheat Pool for each country was recommended, and actually carried into operation in Poland and Yugoslavia. Now a Central Pool is being considered for such state pools as may be formed, in order to deal with the wheat surplus problem more effectively. Apparently the lesson of the late Canadian Wheat pool is lost on these countries.

Running through this book is the note of New Nationalism. New boundaries, enlarging some countries, diminishing others, have created new political units by destroying old economic units. Hungary is the outstanding example. Says the author (Dr. Ivan Edgar Nagy):

> As a result of the World War this classic form of economic unity was pulled into pieces that are absolutely deprived of any economic unity . . . Deprived of raw materials, forests, extensive pastures, surrounded by fantastical boundaries, residual Hungary is completely isolated both politically and economically . . . Hungary became the victim of the so-called "peace treaty" of Trianon.

> . . . The Trianon peace has robbed Hungary of 2/3 of her former territory. Her population decreased from 21,000,000 to 8,600,000. About 4,000,000 Hungarians have been forced under foreign rule as a consequence of the treaty. Hungary has lost 56.30 per cent of her arable lands, 69.42 per cent of her pastures, 84.88 per cent of her forests, 74.53 per cent of her meadows, and 73.87 per cent of her gardens. Practically all of the former territories that supplied Hungary with necessary raw materials such as minerals, salt, lumber, etc., have been segregated from Hungary. Annual imports of lumber cost more than the entire income from Hungarian cereal export . . .
>
> Everybody in Hungary is imbued with the loyal purposes of the Pan-Europe movement and everybody knows the importance and necessity of peaceful economic coöperation with other nations . . . There is no Hungarian who would not trust that justice will be obtained by Hungary, and that this justice will soon come. This belief, this strong trust, is the lodestar of the thousand-year old Hungarian nation and this gives it the moral power to fight the struggle for its existence and for the recovery of its rights that have been trampled in the dust.

This new political nationalism, fatal to old economic nationalism, gives rise to two movements; one, to develop by slow and painful steps a new economic nationalism; the other, to create, by economic ententes, a Pan-Europa. Particularly do these eight agricultural States with their hundred million inhabitants, argue with the "big industrial states" of Europe for such a solution of their problems. Thus far the outlook is discouraging. Say the Rumanian authors (Dr. A. Frundianescu and Professor G. Ionescu-Sisesti):

> Instead of considering these arguments for a United States of Europe, and despite constant recommendations of international conferences and competent organizations of the League of Nations, there is a continued growth in protective tariffs which closes the frontiers to the agricultural products, or which hinders their entrance by very reduced profits, and which does not realize the value of the labor of the agriculturists.

The editor of this symposium, Professor O. S. Morgan, is especially well qualified for his job, by reason of his wide acquaintance in Middle Europe, and his technical training in agricultural economics. He has undertaken a work of great and unusual difficulty, and he has had a large measure of success. As the pioneer in this field, he has made the way easier for those who will come after him. With the exception of the first article in the Symposium—the Austrian —he has secured a translation of his material into clear, idiomatic English.

JAMES E. BOYLE

Cornell University

Straw Votes: A Study of Political Prediction, by Claude E. Robinson. New York: Columbia University Press. 1932. 203 pp.

Measurement in the field of political science is still in the stage of development. New statistical techniques and devices are needed to apply to political phenomena. Most of the studies in this field have used as their unit of measurement the vote, particularly the popular vote and the vote in the legislative assembly. The present study is a pioneer work in the measurement of voting intention, as Professor Chaddock calls it in the "Foreword," and its relation to political prediction.

The straw poll is comparatively inexpensive technique by which popular sentiment on issues or candidates may be secured without going to the stupendous task of canvassing every voter. The legislator, as Mr. Robinson points out, could use it to test the sentiment of his constituency on matters of major importance. The politician could use it to make more reliable the gauging of the election results, and thereby make stronger efforts where they are needed. Straw votes are useful to the newspapermen in that the reporting of the polls are of great interest to readers. And for the student of politics, "the straw poll may serve as a measure of sentiment whereby the workings of public opinion in response to electioneering may be better understood."

Straw polls have been taken on all sorts of issues and campaigns since as early as 1904. Newspapers, weekly magazines, and other organizations have sponsored these straw polls. There have been other political predictors, however, and among these are the politician, the newspaperman, and the political barometer "As Maine goes, so goes the nation." A study of each of these methods of predicting the outcome of elections was made and described in the present work. Politicians were found to be the most inaccurate predictors, while newspapermen were inaccurate for predicting electoral college votes but picked six winners out of the last seven presidents. The Maine barometer was found to be unsatisfactory as a predictor of election results; it is not as sensitive an indicator of national feeling as many persons believed. The *Literary Digest* and the Hearst papers were found to be the most accurate when the various methods of predicting the outcome of elections by the use of the straw poll were examined.

The main problem in political prediction by using the straw poll is one of sampling. Mr. Robinson discusses five specific sampling problems which he noted in his investigation: first, the geographical bias (cities polled more than rural districts); second, the class bias (certain economic groups are polled because of their availability through commercial mailing lists); third, the bias of selection in coöperation (certain classes of people may coöperate with the poll sponsors more readily than others); fourth, the bias of participation-nonparticipation (people may vote in the straw poll and not be eligible or care to vote in the final election); and, fifth, the size of the sample may be too small to be used for prediction purposes.

The task of conducting this investigation on straw polls consumed more than three years. Gathering the data for such a study was a stupendous task. An examination of the many tables of percentage distributions which the author presents is sufficient to convince the reader that the book contains a very exhaustive study. But with all the data collected the reader has a feeling that much more could have been done with them. A rather simple technique of comparing the accuracies of prediction is used throughout the book. No use is made of any refined techniques which would have made the book more of a contribution to this new field of measurement in politics. The discussions of the various causes for errors in prediction and how they may be remedied does not measure up to the problem the author is treating. Remembering that this investigation is a "pioneer work" in this field one can be well

satisfied with the presentation; but, on the other hand, with the wealth of material which must have been collected, it seems that there could have been a more critical analysis.

RICHARD O. LANG

University of Chicago

Taxation of Motor Vehicle Transportation. New York: National Industrial Conference Board. November, 1932. xii, 196 pp.

The American people may have a predilection for uniformity and standardization in certain matters, but the taxation of motor vehicle transportation is not one of them, as this study, largely statistical, amply shows. The Board has here gathered together a large amount of factual material, much of it by correspondence with state officials, and the resulting collection of 43 tables reveals in a striking manner the disparity of practice among the several states, particularly with reference to the license taxes. Many of the tables concern legal and administrative provisions of the license and motor fuel taxes. Since most of this information is not readily available elsewhere, the student of motor vehicle taxation will doubtless find the volume indispensable for reference purposes.

The text is largely a summary of the results revealed by the tables. The Board does not attempt to push very far into the troublesome theoretical aspects of distribution of the highway burden, although it cites certain arguments for and against a number of propositions, and draws heavily on a recent study by the Interstate Commerce Commission. In places certain important considerations are omitted, as for instance the justification of the license tax as a levy on the week-end driver who is the cause of a heavy overhead expense on roads usually employed far below capacity. On the whole, however, enough of the major problems are noted so that the reader should obtain a bird's-eye view of the complexity of the entire problem.

Most of the legal and administrative tables are admirable in their arrangement and comprehensiveness. Some of the statistical tables, or rather the summary figures that are drawn from them, are, on the contrary, open to serious misunderstanding, largely owing to the use of unweighted averages. Discussion in this field is often so clouded that it seems advisable to draw some attention to the point. On page 161, for instance, it is stated that "For trucks with pneumatic tires, the average tax was $521.30 on those operated as common carriers, or 33.7 per cent higher than on contract carriers [$389.99]. . . ." This result is reached by averaging, without weights of any kind, the taxes paid in each state on a hypothetical vehicle—or in other words, each state is given a weight of one. The apparently much heavier burden on common carriers results chiefly from the fact that a few states, most of them small—Arizona, California, Colorado, Iowa, Maryland, Minnesota, North Carolina, South Carolina—levy drastically heavier rates on common carriers. But Massachusetts, New Jersey and New York tax both contract and common carriers at the same rate, Ohio and Pennsylvania show only a slight differential against the common carrier, and the Board's table includes no data for

Illinois. The first group of states had a population of 19 millions in 1930; the latter group, 45 millions. The danger is, of course, that someone may point to the Board's percentage figure as indicative of a nation-wide heavy burden upon common-carrier truckers as compared to contract carriers. In reality, this percentage figure gives virtually no information of value at all. The same type of criticism can be made of other average tax and percentage figures on pages 161 and 162 and of those on page 18.

Doubtless, population is not the best weight, but surely the averages and percentages would be better omitted entirely unless some satisfactory method of weighting could be found, and the reader should at least be warned of the consequences of trying to use these unweighted averages.

The statement on pages 13–14 that net weight ranks first in frequency of use as a weight measure of the license tax, with 72 applications, whereas gross weight comes second with 69, is literally accurate, but possibly misleading to the casual reader, inasmuch as Tables 5 to 10 show that in 16 of the 72 cases the net weight measure is combined with either tons capacity or passenger capacity, which gives much the same result as if gross weight were used. On this basis gross weight would have a commanding lead of 85 to 56.

CARL SHOUP

Unemployment in Germany Since the War, by Kenneth Ingram Wiggs. With an Introduction by Henry Clay. London: P. S. King and Son. 1933. ix, 216 pp.

"The purpose of this study," says the author, "is to find a satisfactory explanation of the high amount of unemployment in Germany since the War" (p. 13). Incidentally it also served as a thesis for the doctorate at the University of London. In the first third of the book are set forth the facts as to the amount and distribution of unemployment and the general state of trade in Germany during the period 1903–31. The rest of the volume is given over to the aforesaid explanation. In its descriptive aspects the work is highly competent, but the analysis, in the opinion of the reviewer, is not altogether convincing. Well planned as a whole, the chapters are rather drearily subdivided; at times, too, there is infelicity in the use of English. This may be due to the urgency, which the author says he felt, to publish at the earliest possible moment.

As a basis for his accurate and detailed description of the facts of unemployment in Germany, Dr. Wiggs employs, for the years 1903–24, the trade union percentages of members out of work. For the period since 1924 he uses, in addition, the statistics of the Ministry of Labor as to the numbers of persons seeking employment. The unemployment aid and insurance figures, published since 1919, he ignores because of limited range and frequent changes in the eligibility rules; he disregards for other reasons the statistics as to persons compulsorily insured under the National Health Insurance system, and the Index of Labor Exchange Activity. Various special inquiries are taken into account.

A preliminary survey of the state of the labor market from 1903, when the trade union percentages were first published, until 1914, brings out certain points of comparison with post-war conditions. First, it is clear that seasonal unemployment was at all times a serious matter—more serious than in Great Britain—but not relatively more burdensome after the War than before it. Second, the long-period fluctuations of employment have been more violent in recent years than they were prior to 1914. And last, the problem of basic, or "residual" unemployment has attained proportions which, despite the impossibility of accurate comparison, are probably more serious than in pre-war times. Extreme localization of unemployment, as in England, is not found in Germany.

As a first step toward explanation of the situation thus portrayed, Dr. Wiggs expresses skepticism as to the approach through cyclical analysis. It is his view that the phenomena of the post-war labor market can best be interpreted in terms of three non-cyclical factors, namely, monetary conditions, scarcity of capital, and high and rigid wage rates. The relatively low level of unemployment from 1919 to 1923 he ascribes to inflation, and the enormous increase in the numbers of the workless at the end of 1923 to the reversal of the relationship between wages and external and internal prices. The serious depression of 1925–26 was due to the necessity for reorganization following stabilization. And here the influence of domestic monetary conditions, as a major factor, ended.

From 1926 to 1929 was a period of recovery, conditioned by capital scarcity and rapidly rising wages. The causes of the lack of capital Dr. Wiggs examines in detail. He criticizes the Germans for reckless borrowing and censures the public authorities for their spendthrift policy in the social services and public works. He emphasizes the rôle of high interest rates in making it difficult for borrowers to cover costs, and the tendency of short term capital to be withdrawn suddenly, thus harassing employers and increasing fluctuations of employment.

High and rigid wage rates, however, due to the new strength of the unions, the spread of agreements and the support of the state, make up the main burden of the author's complaint. In the first place, during expansion they hindered saving and diminished employment. Moreover, from 1925 to 1929 average real-wage costs rose from 83.7 to 119.9 (1913=100), outstripping the increase in production, and thus caused the steady increase in the numbers of persons seeking work. Rationalization, changes in population structure and price-fixing the author dismisses in this connection. Finally, when the slump came, in 1929, wages continued to rise for eight months and in July, 1931, the index had fallen only 6.1 points, as compared with 30 points for wholesale prices, since September, 1929, and 19.6 points for the cost of living. Hence the catastrophic increase in unemployment. "What with wage and general social policy, one is forced to the conclusion that Germany has brought about her own downfall, and that too much emphasis has been laid upon Reparations, which, admittedly, are an additional evil" (p. 188).

One's attitude toward this argument will depend upon one's views as to wage

policy during depression. It is undeniable that wage rates are an important element in the variable costs of industry, and that reduction of wages may aid enterprises that otherwise would cease operation. But it is open to question whether, in the "short-run" of such a depression as overwhelmed Germany in 1930, under such conditions of fixed overhead charges, any practicable reductions in wages would have compensated for the rise in unit costs and prevented, or greatly lessened, the drop in employment. Wage cuts, of course, are inevitable in a depression of any length; the question is, whether the degree to which rates were maintained in 1930 was such as to merit the criticism levelled by Dr. Wiggs at the unions and the state. As to this, I, for one, am skeptical. On the other hand, that union policy in boosting wages was partly responsible for the increase in unemployment prior to 1930 cannot, I think, be denied.

WILLIAM T. HAM

Harvard University

The Modern Corporation and Private Property, by Adolph A. Berle and Gardiner C. Means. New York: The Macmillan Company. 1933. 396 pp.

Many recent books purport to show the definite breakdown of economic processes and the need of revolutionary change. Less frequent but more significant is the type of work that traces the course of revolutionary change as it proceeds beneath our very noses. The present work, the joint effort of a lawyer and an economist under Social Science Research Council auspices, is of the latter sort. The idea is not new that the large corporation—quasi-public by virtue of the great number of its shareholders—is a party to important changes and problems. But the precise nature of the changes and the broad meaning of the problems have not heretofore been so effectively stated. Against the background of economic arrangements described by Adam Smith and his successors, the modern corporation—"a method of property tenure and a means of organizing economic life"—is seen as creating a new structure, "the corporate system," as compelling and distinctive as was the feudal system. The large corporation is thus revolutionary because it strikes the very heart of the older system through separating industrial control from ownership and the assumption of risk. With the interests of owning and managing groups diverging, more is at stake than the rights of scattered stockholders, though these are sufficiently important. The nature of property itself is changed, with the satisfactions and responsibilities entailed in its possession; and, more fundamentally, the social function of profits, in guiding and stimulating productive effort, is undermined. A limited number of individuals, in a capacity more managing than owning, are largely able to substitute their will and judgment for the broad, blind, automatic play of market forces. These conclusions the authors reach by methods whose variety adds interest to the work; statistical research, legal investigation, general economic reasoning, and free speculation all participating in the result.

The statistical study is concerned with the growing importance of large cor-

porations and the increasing diffusion of their ownership. Of 300,000 corporations in the country, the 200 largest non-financial corporations, with gross assets of upwards of $90,000,000, were found to own nearly half of all non-financial corporate wealth, about 33 per cent of all non-financial business wealth, and approximately 22 per cent of the country's total wealth. These 200 corporations, through reinvesting a larger fraction of their earnings, through security issues amounting (1922–27) to two-thirds of all public offerings, and through merger, have been growing more than twice as fast as other corporations. The seeming vitality of these enterprises suggests a continuation of the trend. Elaborate tabular displays reveal that most of these corporations are owned by many thousands of persons, with individual holdings, even of management, fractionally inconsequential. An interesting attempt to classify "control" in these 200 enterprises leads to the conclusion that, on the basis of the assets involved, only 6 per cent are controlled by majority stockholding, 14 per cent by substantial minority holdings, and 80 per cent either by management with little stock or by such a legal device as pyramiding or the use of non-voting stock. Thus "ownership of wealth without appreciable control and control of wealth without appreciable ownership appear to be the logical outcome of corporate development."

More than half the volume is devoted to analyzing, mainly along legal lines, the nature of property in corporate securities. With control largely divorced from ownership, the stockholder's position has been greatly weakened by recent corporation laws and the charters drawn under them. But for the amorphous principle that management stands in fiduciary relation to shareholders, the latter would seem, by act of purchase, to agree to thoroughgoing despoliation of themselves through the machinery of no-par stock, paid-in surplus, denial of preëmptive rights, stock-purchase warrants, blind and "parasitic" stock, combined with a broad latitude in rearranging participations through charter amendment. But so little disposed are the courts to censor the requirements of "business expediency" that the doctrine of "corporate powers in trust" is slight protection to security-owners, who must therefore rely upon the disposition of management to deal fairly and safeguard the future flow of capital into industry. The actual extent of victimization of shareholders is not appraised by the authors. With "active" wealth thus locked up in vast industrial units, the property of the ultimate owner depends considerably on the operation of security markets in assigning values and affording salability to the various equities. This aspect of corporate property rests largely on prevailing requirements surrounding the disclosure of significant facts by bankers and by the corporations themselves, and upon the market activity of "insiders." But in this connection a void seems to exist both in legal and economic theory.

Quite properly, and with fine effect, the authors have set forth what, to them, are the larger economic implications of their findings. It may appear, however, to some readers that the separation of ownership and control in large corporations has been awarded a somewhat more revolutionary significance than it deserves. The older social function of profits as reward both of

risk-bearing and of management may not apply, it is true, when these duties are divided; and certainly no social gain derives from granting ownership a larger reward than the waiting and risk-taking functions require. But the ordinary measure of net earnings for a corporation, as compared with a single enterprise, already largely reflects this division of entrepreneurship; and if, for the sake of an adequate incentive, it seems desirable to compensate management liberally with commissions or bonuses dependent upon earnings, the step is not especially revolutionary, however subject to abuses at the outset. That "extra profits" go to ownership beyond the socially justifiable amount and should be rerouted to "control" requires definite demonstration. "Pure" profits may already be negative, on the broad average; and, in any event, the existence of a *prospect* of profit more than sufficient to induce the assumption of business risk is not to be taken for granted. Such influence on net earnings as may be exerted by contractual interest rates and by monopoly lies, of course, outside the area of discussion, since they involve issues quite different from the separation of risk and control in corporations.

But if, as may plausibly be contended, the theory of the profit system in any guise must fail to work; if now more is to be learned of economic motivation from an Alexander the Great than from Adam Smith's petty tradesman; if a wholly new concept of business enterprise has become necessary; even so, the corporate form of organization with its separation of ownership and control may easily be accorded too prominent a place in the explanation. After all, if huge business units have the assured future in which the authors believe, it is because the technological conditions of production require them. Here, then, the revolution lies. The corporation form of organization is merely a means, however indispensable, to their establishment. If it should appear that "bigness" is largely due, not to the conditions of progress in supplying goods, but to opportunities, afforded by the corporate form itself, for profits and power from monopolistic combination and from the very promotion and underwriting and controlling of great enterprises, then, perhaps, the apparent trend toward bigger units would not be looked on as inevitable, except by supporters of *laissez-faire*—which the authors plainly are not. If a system of free enterprise, with its machinery of profits and competition, is still compatible with the scale of enterprise and diffusion of ownership economically necessary, then conceivably the framework of organization can be adjusted to this situation. If not compatible, but private ownership of industry is to continue, then we may look for amendment of the corporate device along lines in keeping with some such new conception of business enterprise as the authors suggest may come to prevail.

SHOREY PETERSON

University of Michigan

Studies in English Trade in the Fifteenth Century. Edited by Eileen Power and M. M. Postan. (London School of Economics: Studies in Economic and Social History, V.) London: George Routledge and Sons. 1933. xx, 435 pp.

This group of essays on the history of English trade is the work of the seminar in economic history at the London School of Economics, supplemented by material and an essay contributed by Professor H. L. Gray. Although the studies do not present a comprehensive account of the movement and organization of fifteenth century trade they contribute a large amount of new material to a neglected period. As the primary materials in the Customs Accounts have been tabulated for the entire period 1399–1482 and are printed in full in the appendices, the volume has a very broad significance. No previous study has furnished so large a mass of material for the statistical study of English trade in the middle ages.

The material presents various difficulties. Exports of wool and cloth and imports of wine are reported in units of quantity. The trade in other commodities is reported without discrimination in the statements of the petty customs and the poundage duties. Unfortunately, exports and imports are not distinguished. Nevertheless, by careful utilization of contemporary materials Professor Gray has been able to present an approximate table of the average value of exports and imports for the periods 1446–48 and 1479–82.

AVERAGE ANNUAL VALUE OF EXPORTS AND IMPORTS

ENGLAND, 1446–48

Exports

	Wool	Cloth	Miscellaneous	Total
	(Thousands of pounds sterling)			
Staplers	44.8	....	....	44.8
Merchant adventurers	....	60.1	4.0	64.1
Total denizens	44.8	60.1	4.0	108.9
Hansards	....	23.3	2.0	25.3
Other aliens	11.2	32.0	5.0	48.2
Total aliens	11.2	55.3	7.0	73.5
Total	65.0	115.4	11.0	182.4

Imports

	Wine	Wax	Miscellaneous	Total
	(Thousands of pounds sterling)			
Staplers	....	....	....	....
Merchant adventurers	32.7	0.0	53.1	85.8
Hansards	....	1.0	19.8	20.8
Other aliens	12.4	....	27.7	40.1
Total aliens	12.4	1.0	47.5	60.9
Total	45.1	1.0	100.6	146.7

Owing to the vicissitudes of foreign and civil wars, the trade of the latter period is only slightly greater than the trade of the earlier period, so that the interest of the study lies in the commodities and in the proportions of the trade in the hands of natives and aliens rather than in growth. The general results of the study are thus summarized in the statements of exports and imports.

The other essays in the volume constitute an extended commentary on the primary elements of these tables. The operations of the Staplers is the subject of the essay on the wool trade and an essay on the relations of the Staplers with the Lancastrian government. The relations of the Merchant Adventurers to the Great Livery Companies, which have been very incompletely understood in the past, are studied in the light of extensive masses of new material in the essay on the Grocer's Company. There is also an essay on the Hansards based on recent German literature and the large masses of documentary material now available in print. Studies of the Iceland trade and the foreign trade of Bristol furnish important evidence on special topics. The volume thus affords a basis for a thorough understanding of the organization and movement of England's trade in the fifteenth century.

ABBOTT PAYSON USHER

Harvard University

Social Statistics, by R. Clyde White. Harper's Social Science Series, edited by F. Stuart Chapin. New York and London: Harper and Brothers. 1933. x, 471 pp.

This is the first text-book in the United States that deals adequately with elementary statistics as applied to sociology and social work. Mr. White has been successful in fulfilling his aim which was to "adapt statistical methods to the data of sociology and social work for teaching purposes. . . ."

The book is presented in two parts. Part I, Introduction, contains more than is ordinarily found in an introduction. The first chapter gives the usual preliminary material, and the second a discussion of the "Sources of Published Statistics." This is not merely a listing but is also a discussion of the various kinds of agencies engaged in collecting statistics. This type of discussion is very helpful in view of the rapid change in the field of social data. Chapter three, "The Nature of Statistical Research," reconciles case work and statistical research. Case work has long been the fort and often the sole tool of social workers so that now there is great need for training in statistical techniques. The case method and statistical method should be complementary. In chapter four, the last in Part I, the author has described the working out of two statistical problems: one done by himself using primary data on cases disposed of by the Marion County Criminal Court of Indianapolis, Indiana, and the other, a problem using secondary sources, "Social Aspects of the Business Cycle," by Dorothy S. Thomas.

Part II, Statistical Analysis, with two exceptions, presents chapters on the ordinary range of subjects in the following order: collection, tabulation, graphic

presentation, measures of central tendency, measures of dispersion, index numbers, measures of relationship, the theory of probability, and time series. There are at the end two chapters which are not usually found: one on vital statistics and one on rating scales.

The discussion of tabulation is excellently done for teaching purposes, although as is often the case, the illustrations being set in type do not rigidly follow the rules discussed. "Graphic Presentation" is introduced with a discussion of rectangular coördinates and is followed by a treatment and illustration of line graphs of various kinds, frequency histograms, polygons and curves, bar graphs, circle and sector diagrams, maps, and an organization chart. Scattergrams, not discussed as a graphic device, are included as a supplement to correlation analysis later.

The chapter on averages treats the mode, median, arithmetic mean and geometric mean. Here is a very clear discussion of the reason for using a mid-point of a class-interval in the computation of the arithmetic mean from a frequency distribution, but no explanation is given for the use of that same mid-point in computing the geometric mean, although the author of the book clearly recognizes that the geometric mean is smaller than the arithmetic mean. The chapter on index numbers gives a good discussion with illustrations of actual computations. The author has not been consistent with his use of symbols however. At first he uses w to indicate weights and then changes to q when discussing Fisher's Ideal Formula. His use of subscripts in this chapter is not uniform.

Mr. White has been very careful to give a clear statement of the problem of correlation. He has tried but has not been very successful in getting away from the old "cause and effect" description of the subject. "Instead of speaking of one fact as a cause and another as an effect of the first, it is the habit to speak of one fact as the *independent variable* and of the second as the *dependent variable*. In some cases the dependent variable might just as well be treated as the independent variable" (p. 178). But, he has earlier defined variables: "Variables may be classified as independent and dependent. This means that one series of facts to which another series is related is treated as cause, and that the second series changes in accordance with the first" (p. 68).

Correlation is introduced by presenting the meaning of a functional relationship and the standard error of estimate from a curve. White doesn't get to the algebraic definition of a coefficient of correlation until his 20th page. This is the first elementary text in statistics which defines and makes use of the corrected r and S_{xy}. No mention is made of part, partial or multiple correlation. The method of rank correlation which may be of considerable advantage, particularly in some fields of social statistics, is likewise not treated.

The theory of probability has been presented in a manner similar to that of Mills' *Statistical Methods*. In the computation forms for the fitting of lines in the chapter on relationships and in that on trends, the symbol U has been introduced for X^2. This added symbol serves only to confuse. The chapter on time series comes farthest from meeting White's ideal of teachability. The chapter does not come up to the standard set in the rest of the book for

clear statement and complete description. At many points it is difficult to understand and is very confusing.

The chapter on vital statistics serves the purpose of a chapter on rates as well as to present in simple manner the problems related to population, viz., growth, marriage and divorce, birth rates, death rates and morbidity. The second exceptional chapter discusses the problem of rating scales which has come to be of considerable importance in recent years. Examples of different kinds of scales are given.

The book is well printed and securely bound. Relatively few errors in printing have crept in, although there are a few, such as the turning of the graph on page 155. This book can be used without a laboratory manual if desired since exercises appear at the end of each chapter. References to collateral reading follow each subject treated.

LESTER S. KELLOGG

University of Buffalo

Contributions to the History of Statistics, by Harold Westergaard. London: P. S. King & Son. 1932. viii, 280 pp.

Statistics is probably older than economics. Even if the earlier German university statistics be left out of account, the origin of the study can be traced back to A.D. 1662 when Graunt's *Natural and Political Observations* was published, and at that date modern economics had produced no book that proved equally seminal. Statistical societies, which have done much to foster an interest in the history of their field, have been active perhaps twice as long as economic societies.

Notwithstanding the fact that economics is the younger study its history has been treated much more fully than that of statistics and accordingly the present "Contributions" from one who has greatly enriched the latter subject is to be cordially welcomed as helping to fill a lacuna in our knowledge. The author believes that the three main roots of statistics are Staatenkunde, or the comparative description of states, political arithmetic, and the calculus of probabilities, the first originating in Germany, the second in England, the third in Italy and France. He aims to show how they have blended into the statistics of today. The book is composite not only because the author so conceives the subject, but because its development in different countries has varied both in direction and in speed. A real history of statistics as an international discipline must probably wait until more spade work has been done in the history of statistics in the several countries. In the present work the geographical classification sometimes interferes with the logical, although in the later period when statistics became more international this difficulty dwindles.

Professor Westergaard's conception of statistics is one he elaborated more than half a century ago in his first book. During that interval it has not won general acceptance or even gained much ground. What recent writer begins, as our author began the 1882 edition of his *Mortality and Morbidity*, with an

explanation of the law (so-called) of large numbers and the concept of probability? Mathematical principles, to be sure, can be used to test many statistical results, but are they the only test? Does not the congruity of the conclusions reached in statistics, as in the physical sciences, constitute an important test of correctness? Perhaps Professor Westergaard's approach to statistics through actuarial studies (he dedicated his first book to an English actuary) has led him to emphasize more than others the mathematical phases of his subject.

Even if one agrees with him that statistics is a blend, the question still arises whether its components have been rightly conceived. Perhaps it is, as Knies said long ago, both a method and a science. If so, the history of either might be coherent, but a consecutive history of the two is hardly possible. If statistics be a method, then its achievements in the physical sciences, hardly mentioned by Westergaard, deserve recognition. If it be a science, demography, based on complete enumeration, then his chapter on Staatenkunde might be omitted and his emphasis on the calculus of probabilities diminished. With complete enumeration it seems unnecessary to invoke the calculus to adjudicate upon the trustworthiness of the results for the population enumerated and at the time of enumeration, and the question whether those results will apply to the same group at another time turns upon the rate of group change where, again, abstract mathematics is of little help. The calculus becomes important when the question is whether what is true of a sample is true of the whole. But even there, while it throws light on the question whether the sample is large enough, it throws little on the question whether it is representative.

We echo the author's hope that the book will prove to be the forerunner of a projected forecast for the future of statistics, a study to which his life has been devoted and in which he has garnered an abundant harvest. Few indeed are better equipped to anticipate the trend of statistics in the next generation.

WALTER F. WILLCOX

Foreign Investments in China, by C. F. Remer. New York: The Macmillan Company. 1933. 708 pp.

Professor Remer has undertaken in his *Foreign Investments in China* a very difficult task and has performed it well. He has made an important contribution to the understanding of economic conditions in the Far East. The field is one in which the data are incomplete and inaccurate as well as complicated, but the importance of bringing together, for the first time, material on foreign investments in China as a whole is sufficient justification for the use of such data. The study has been carried on over a number of years and is based not only upon the research and investigations of the author in China, Japan, Russia, Germany, France, England and the United States, but also upon independent investigations of the Institute of Pacific Relations in Japan, the Royal Institute of International Affairs in Great Britain, and of well-known economists in Russia and China. One of the difficult tasks of the study has been the merging of these separate investigations into a comparable whole;

and one of Professor Remer's contributions has been to point out the weaknesses and the gaps in the material.

The book is divided into two parts. In the second part the author has presented the results of the separate investigations, by countries, not as they were turned over to him, but rearranged and made comparable and with additions from his own store of information. Part I presents the final results of the whole study and the author's analysis. It gives the complete story so that it is not necessary for the reader to go into the details of Part II unless he is especially interested in the field or in the methods used in making the estimates. There is, however, a great deal of interesting material to be found in Part II.

The first four chapters of the book supply a background of conditions in China necessary to the understanding of the problem under investigation. The remainder of Part I is given over to the analysis of foreign investments in China and their place in China's balance of payments. The analysis shows the continued preponderance of British interests in foreign investments in China and the important increase, since the World War, of the investment interests of Japan—a normally capital importing nation. It shows the concentration of foreign interests in Shanghai with the British in the lead and the Japanese gaining in importance, and the growing significance of Japanese interests in Manchuria. It points out that transportation has been the dominant field of foreign investment with trade coming next and manufacturing and real estate in third and fourth place.

It further discloses that the preponderantly important share of foreign investments in China is and always has been in the form of direct business investments, rather than in loans to the Chinese government or investment in Chinese institutions, and that direct investments by foreign nations and by private interests have, at times, been the instrument of political intrigue for the acquisition of Chinese territory or other political gain. That there has been almost no investment through Chinese corporations is pointed out and explained, in part, by the lack of Chinese experience in the operation of industrial plants, by the fact that the Chinese corporation seldom borrows as long as the corporation is financially successful, and in the difficulty of handling matters that go before a Chinese court. Foreign indebtedness by the Chinese government began with loans to meet the indemnity imposed by Japan after the Sino-Japanese War and although in the intervening years there has been some borrowing abroad for economic purposes, mainly for railway construction, it has not been great and the bulk of the foreign obligations contracted by China has been as a result of war, anti-foreign disturbances, civil strife and political intrigue. As Professor Remer says, the Chinese government has been an indemnity paying institution rather than a capital importing institution, and he believes that a fundamental problem in China today is the creation of a Chinese government which will provide the leadership for the economic development of the country.

The place of foreign investments in the international balance of payments has been assessed and the author has made a new estimate of the Chinese balance of payments disclosing a large unexplained difference between outpay-

ments and inpayments not accounted for by foreign investments, remittances from overseas, or expenditures of foreigners in China.

The author believes that there is need of further investment of foreign capital in order for China to find a way to live in the modern world but he thinks that China must have that foreign capital without political domination or economic exploitation. He urges the importance to the world of raising the low standard of living of the Chinese millions and the necessity of directing the use of foreign capital to that end.

It is possible to criticize some of the estimates and some of the methods used, but the author is scrupulously honest in his statistical presentation and is fully conscious of the weakness of his data. In spite of the technical aspects of the study and the generous use of tables, charts and statistical material, *Foreign Investments in China* is very readable. It is simply and clearly written and carefully summarized at the end of each chapter. Professor Remer has not been overwhelmed by the mass of statistical material. He brings to his statistical analysis a genuine appreciation of China's political and economic problems.

Columbia University JOHN E. ORCHARD

Growth of Trade and Industry in Modern India, An Introductory Survey, by C. N. Vakil, S. C. Bose and P. V. Deolalkar. London: Longmans, Green and Company, Ltd. 1931. 398 pp.

Growth of Trade and Industry in Modern India is a sincere attempt to analyze the problems of India's industrial and commercial growth under British rule. It presents the Indian viewpoint and as such has a distinct value. The authors believe that though India's immediate problem seems to be political, the real problem is economic, and they ask the question how beneficial to the Indian people have been the foreign trade and modern industry developed under British domination. They look at the preponderance of raw materials in export and of manufactured goods in import and question the wisdom, for India, of the British policy that has insisted until recently upon free trade and has stimulated industrial agriculture but retarded the development of modern manufacturing. The steadily rising excess of exports over imports is not evidence of prosperity to the Indian, but of a drain upon the raw materials which the Indian people themselves might use to build a new industrial economy; the foreign capital and foreign management in trade and industry mean lost opportunity, the outflow of profits to non-Indians, and the loss of valuable experience, enterprise and knowledge of technique which given to Indians would help them to rebuild their economic structure along modern lines. The book is divided into four parts. The first part concerns the trade in food grains, the development of the tea and coffee trade, the sugar industry and salt. The second part deals with the various textiles; the third part with minerals; and the fourth with a miscellany of industries. Some very useful and interesting historical data have been assembled and the possibilities and obstacles to future development in each field are discussed in the light of the welfare of the Indian people.

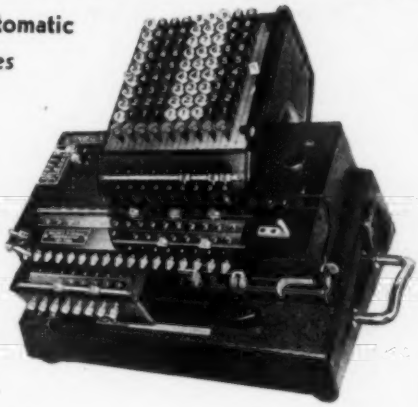
Columbia University JOHN E. ORCHARD

MERCEDES EUCLID CALCULATING MACHINES

The Super-Automatic *Mercedes*

Multiplies and Divides Automatically

A limited number of factory reconditioned *Mercedes* now available. All models from manual operation to full automatic electric. Every machine carries a complete new machine guarantee.



Milled and Cut Construction

A *Mercedes* Purchase is a Long Term Investment

PRICED FROM

$40.00 UP

Convenient Terms Arranged — **Trades Considered**

Write or phone

RALPH C. COXHEAD CORPORATION

17 PARK PLACE, NEW YORK — **BArclay 7-2837**

Books Obtainable at Specially Reduced Prices by Ordering through the

AMERICAN STATISTICAL ASSOCIATION

To secure discount, payment in advance is necessary

Business Cycles and Business Measurements by Carl Snyder, *Past President of the American Statistical Association*..... $4.75 **$4.00**

Industrial Fluctuations by Arthur C. Pigou, Dean of English Economists... $8.50 **$7.50**

The Problem of Business Forecasting — Proceedings of the 1923 Annual Meeting of the American Statistical Association. Edited by Warren M. Persons, *Past President of the American Statistical Association* $4.00 **$2.00**

Population Problems — Proceedings of the 1924 Annual Meeting of the American Statistical Association. Edited by Louis I. Dublin, *Past President of the American Statistical Association*..... $4.00 **$2.00**

Employment Statistics for the United States by *The Committee on Governmental Labor Statistics of the American Statistical Association.* Edited by Ralph G. Hurlin and William A. Berridge..... $2.50 **$2.00**

Statistics in Social Studies by *The Committee on Social Statistics of the American Statistical Association.* Edited by Stuart A. Rice. $3.00 (paper) **$1.50**

Index Numbers Elucidated by Willford I. King..... $2.50 **$1.90**

Statistical Procedure of Public Employment Offices — prepared for the Committee on Governmental Labor Statistics of the American Statistical Association by Dr. and Mrs. Bryce M. Stewart..... $2.50 **$2.25**

Currency and Credit by R. G. Hawtrey, $6.00 **$4.80**

The Art of Central Banking by R. G. Hawtrey, $5.00 **$4.00**

The Gold Standard by R. G. Hawtrey, $1.60 **$1.30**

Real Wages by Paul Douglas.... $7.50 **$3.75**

Value Theory and Business Cycles by H. L. McCracken..... $4.00 **$3.20**

American Agricultural Villages: 1930 — An Analysis of Census Data by Irving Lorge under the direction of Edmund de S. Brunner (Monograph No. 1 of the American Statistical Association)..... $1.00 **$ .50**

The Incomes of Physicians by Maurice Leven..... $2.00 **$1.70**

One Set of Four Volumes Dealing with Social Statistics in the United States by Stuart A. Rice, Florence DuBois, Joseph V. DePorte, Meredith B. Givens and Ernestine Wilke..... **$2.00**

Note: Prices shown in light face type are the publishers' list prices; prices shown in bold face type are our own special prices.

INTERNATIONAL LABOR OFFICE

Geneva, Switzerland

MEMBERS of the *American Statistical Association* and other social science groups are cordially invited to write to the **WASHINGTON BRANCH, INTERNATIONAL LABOR OFFICE, 734 JACKSON PLACE, WASHINGTON, D. C.** for information concerning any phase of I.L.O. work, or for a Catalogue of Publications. A list of the regular publications of the Office is given below:

1. **INTERNATIONAL LABOR REVIEW** (*Monthly*).
Articles on industrial affairs, wage and unemployment statistics, etc.
Price: per no., 60 cents; per year $6.00

2. **INDUSTRIAL AND LABOR INFORMATION** (*Weekly*).
Current events affecting industry and labor, immigration and the work of the International Labor Organization.
Price: per no., 15 cents; per year $7.50

3. **OFFICIAL BULLETIN** (*At irregular intervals*).
Official information on matters connected with the life and work of the International Labor Organization.
Annual subscription $1.00

4. **LEGISLATIVE SERIES** (Trilingual) (*Annual*).
Reprints and translations of laws and regulations affecting labor in different countries.
Annual subscription (volume or advance prints) $8.75
Annual subscription (both) $15.00

5. **INTERNATIONAL SURVEY OF LEGAL DECISIONS ON LABOR LAW** (*Annual*).
Price $2.00

6. **INDUSTRIAL SAFETY SURVEY** (*Bi-monthly*).
A link between those in all countries interested in accident prevention.
Price: per no., 30 cents; per year $1.50

7. **DOCUMENTS OF THE INTERNATIONAL LABOR CONFERENCE** (*Annual*).
The Questionnaires and Reports issued for the Conference, the Director's Report, the Final Record of each Session and the texts of the Draft Conventions and Recommendations adopted.
Annual subscription $10.00

8. **BIBLIOGRAPHY OF INDUSTRIAL HYGIENE** (Trilingual) (*Quarterly*).
Price: per no., 30 cents; per year $1.00

9. **I.L.O. YEAR BOOK** (*Annual*).
Survey of Social and Economic Movements and Labor Legislation.
Paper bound $3.00
Cloth bound $4.00

10. **STUDIES AND REPORTS.**
Monographs on various labor problems, e.g., *Statistics, Immigration, Unemployment, Wages & Hours, Industrial Hygiene, Industrial Organization, Cost of Living, etc.*
Annual subscription $10.00

11. **ENCYCLOPEDIA OF INDUSTRIAL HYGIENE.**
Information concerning unhealthful industries or processes.
Price: (1) Brochure edition $16.00
(2) Volume edition $16.00
(3) Brochure and volume edition $20.00

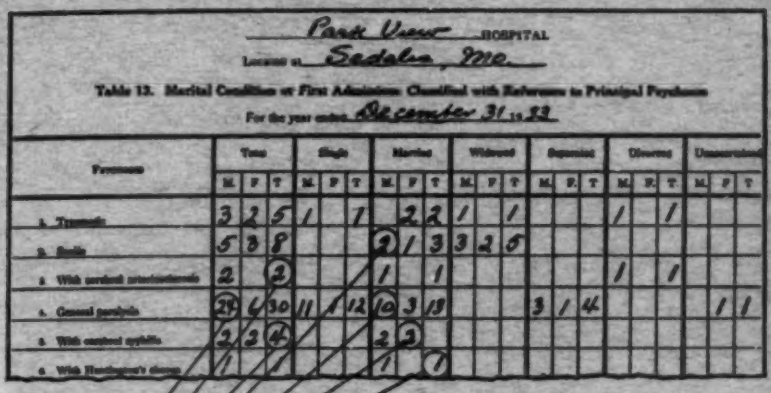
12. **INTERNATIONAL LABOR DIRECTORY.**
Guide to industrial organizations, both official and unofficial.
Price $3.25

The *Encyclopedia of Industrial Hygiene* (11) and the *International Labor Directory* (12) are "Special Reports." Any brochures of the former and any parts of the latter published during the period covered by the subscription are included in the all-inclusive subscription price, which is $40. All prices and rates are postpaid.

RUMFORD PRESS
CONCORD, N. H.

A Time-saver for Statisticians

. . . the ELECTRIC RECORD-COUNTING SORTER



Park View HOSPITAL
Location: Sedalia, Mo.

Table 13. Marital Condition on First Admission: Classified with Reference to Principal Psychoses
For the year ended December 31, 19 33

Psychoses	Total			Single			Married			Widowed			Separated			Divorced			Unascertained		
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
a. Traumatic	3	2	5	1		1		2	2	1		1				1		1			
b. Senile	5	3	8				2	1	3	3	2	5									
c. With cerebral arteriosclerosis	2		2				1		1							1		1			
d. General paralysis	24	6	30	11	1	12	10	3	13				3	1	4					1	1
e. With cerebral syphilis	2	2	4				2	2													
f. With Huntington's chorea	1		1				1		1												

International Electric Record-Counting Sorter

A RAPID, accurate and economical method of counting and distributing units of any description is provided by the Electric Record-Counting Sorter, a recent addition to the line of International Electric Accounting and Tabulating Machines.

Because of its speed and automatic features, and the use of tabulating cards, this device greatly simplifies the compilation of data concerning individual units.

Four hundred units can be classified and counted *in one minute*. As many as twelve unit breakdowns are possible. The totals for these twelve conditions, a sub-total and a grand total are simultaneously secured and indicated.

The benefits of this device are available to statisticians through the International Tabulating Service Bureau at moderate rates.

International Business Machines Corporation

TABULATING MACHINE DIVISION

General Offices
270 Broadway
New York, N. Y.

Canadian Division
500 Campbell Ave.
Toronto, Ont.

Offices and Service Stations in All Principal Cities of the World